

EDITORIAL
LIBRARY

INTRODUCING THE NETWORK EDITION

More extensive coverage of networking products and LAN technology for a select group of PC MAGAZINE readers

In This Issue: Pentium servers, high-speed LANs, and much more...

PC Labs Tests
The Newest
And Hottest

Pentium Machines

NETWORK
EDITION

UNISYS PW²
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From
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To Servers

IBM PS/2
SERVER 95

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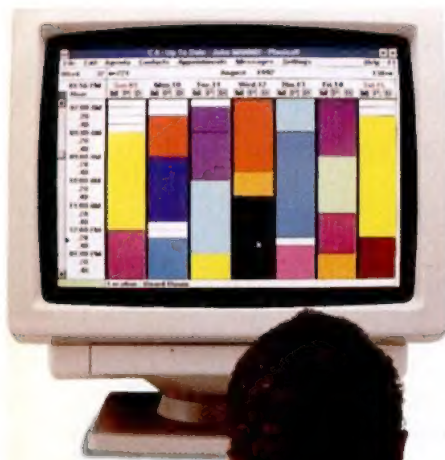
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CIRCLE 026 ON READER SERVICE CARD

Inside

Got 250,000 files you can spare? That's how many our graphics software team decided it needed to test document management software. After all, if you're going to manage the business of a corporate department with this stuff,

you might as well think big.

Our team turned to Ziff Information Systems, an affiliate of our parent company, for help. ZIS wrote a program to cull 200,000 documents from its on-line database and our PC Magazine Labs staff converted them to Microsoft Word, WordPerfect, Lotus 1-2-3, and other formats for the rigorous tests that appear in "Document Management: The Painful Transition."

Broad horizons is the man-

had her verses published in a number of literary journals.

PC Labs Project leader Jeff Mace worked as a drug/suicide prevention counselor before getting hooked on computers. He has had jobs doing tech support for DTP programs and worked as a software developer on both the Mac and PC platforms. Staff Editor John Moore was an associate editor at *Videography*, a magazine for video professionals, until he joined us. Labs support tech



The graphics software team: Ehrenman, Mace, Moore, and Amoroso.

date for our graphics software team, which wrestles every week with one of the most demanding and exciting categories in the PC industry. Motion video, paint programs, desktop presentations, CAD, and image editing are just some of the products under their broad umbrella.

It takes an eclectic bunch to cover such a wide span. Gayle C. Ehrenman, the associate editor for graphics software, has an MFA degree in poetry and has

Tom Amoroso studied marketing and architecture and brought us expertise in CAD software. But what about those 250,000 files? "They proved to be a nightmare for these packages," says Mace. One of the vendors simply packed up and left when his software choked on our demanding series of tests. That may seem tough, until you consider what could have happened if you bought the wrong package.

—Joel Dreyfuss

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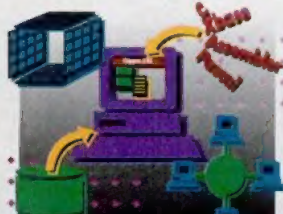
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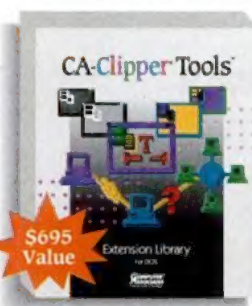
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Nested Multidimensional Arrays	YES	NO	NO
Predefined Object Classes	YES	NO	NO
Variables Modifiable in Debugger	YES	NO	NO
Customizable Reactive Error Handling	YES	NO	NO
Reads and Writes FoxPro (.CDX) Files	YES	YES	NO
Reads and Writes dBASE IV (.MDX) Files	YES	NO	YES
Reads and Writes Paradox (.DB/.PX) Files	YES	NO	NO

Comparison based on FoxPro Version 2.5 for DOS and dBASE IV Version 1.5.



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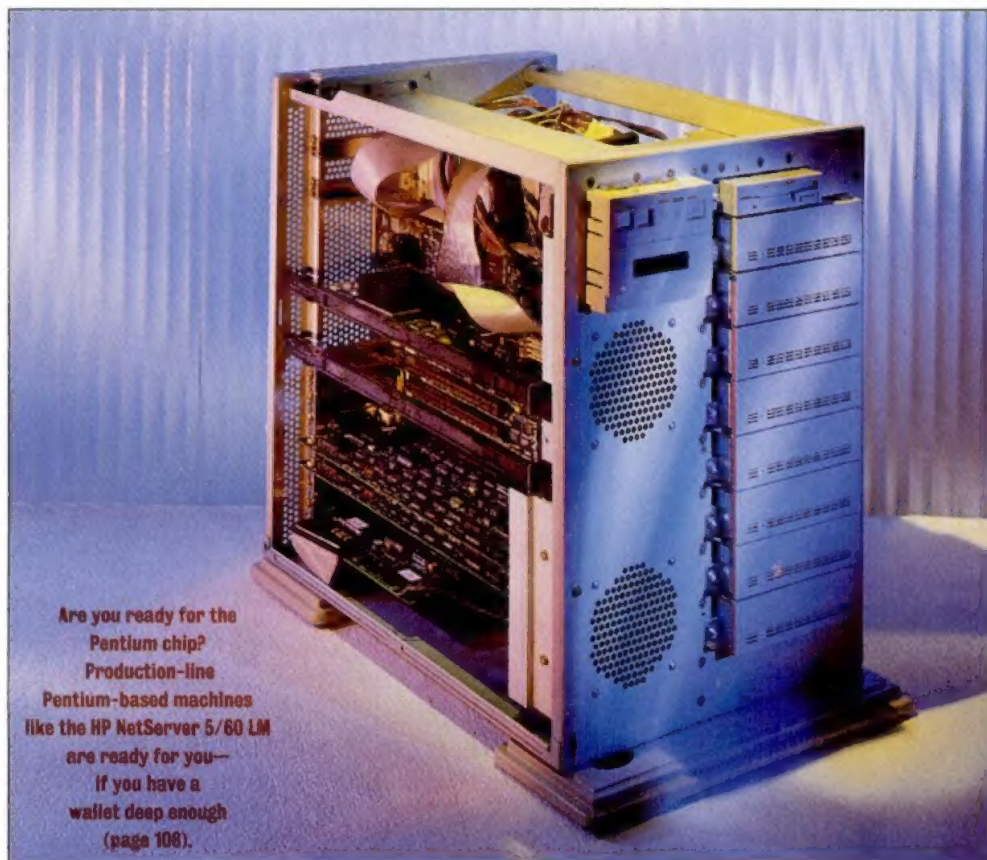
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Are you ready for the
Pentium chip?
Production-line
Pentium-based machines
like the HP NetServer 5/60 LM
are ready for you—
if you have a
wallet deep enough
(page 108).

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Document Management: The Painful Transition

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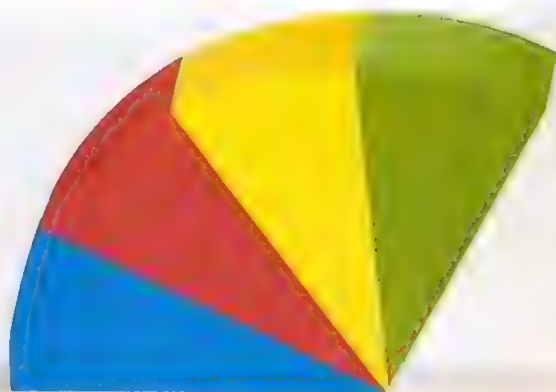
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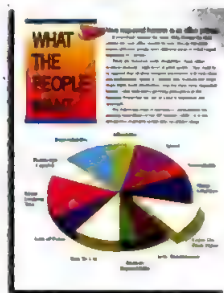


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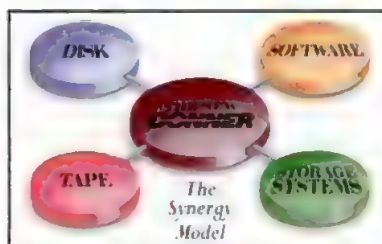
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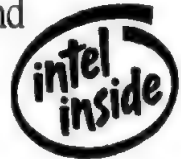
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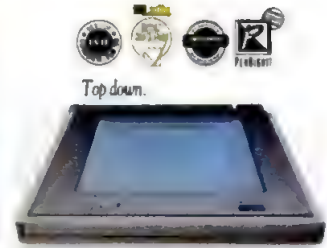


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CIRCLE 342 ON READER SERVICE CARD

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In Mr. Magoo's case, what he can't see covers lots of territory. For the rest of us, it includes things like invisible electronic emissions.

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It's a difference even Magoo can appreciate. Take our new flat-screen 15" color monitor (SC-528DXL), for example. Together with a fine-grained 0.28 dot pitch and 1,024x768 high resolution, it gives you a picture that is not only steady, but crisp and clean.

The same can be said of our economical 14" color monitor (SC-428TXL).

Both are VGA and VESA compatible.

As we said, they all come with VLMF. Plus something else worth looking for.

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Letters

DOS 6.0: THE ULTIMATE CONTROVERSY

I've been following the press surrounding MS-DOS 6.0, and I'm still left with the nagging question: Why? It's clear that very little change has been made to the underlying operating system. This update is strictly for the utilities. I already have what I consider to be the best of all those utilities, and the DOS versions included in 6.0 are scaled down and lack many features. Should I shell out the money for something that won't change the way I compute a bit?

I wouldn't mind upgrading to DOS 6.0, but it's the hidden costs that bother me. I'm being flooded with letters from vendors offering upgrades to their products that are DOS 6.0-compatible. I just upgraded all my software to Windows at a significant cost, and now I'm getting hit for another round. Microsoft is capitalizing on its control of DOS, knowing it will sell because it's crucial to every PC. They should have offered the utilities as a DOS accessory pack so users could choose to buy it based on its merits, not because it is DOS 6.0.

*Evan M. Kaminer, M.D.
Hoboken, New Jersey*

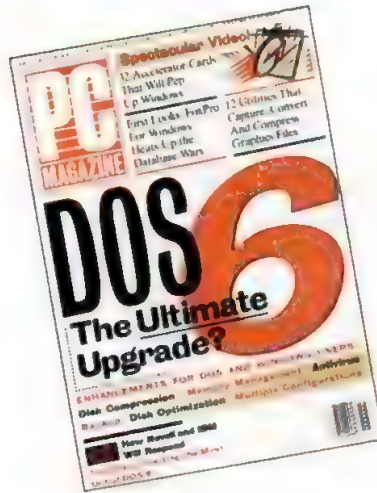
Microsoft should have named its DOS 6.0 DOS 5.1. Unlike other DOS upgrades, there are no improvements to the operating system. Investing in the DOS 6.0 upgrade isn't worth the cost. The company is really trying to pull the wool over our eyes this time.

*Jack Allen
Pacific Palisades, California*

YOU CAN'T KEEP A GOOD DOS DOWN

How can you call DOS 6.0 the "Ultimate Upgrade" and then reduce DR DOS 6.0 to a small sidebar in which you claim the product is in "suspended animation?" Users of DR DOS find it quite animated, and the Novell support staff is a concerned crew that actually calls back to see if problems have been resolved. DR DOS set the standard, Microsoft is playing catch-up.

*Malcolm Dean
Los Angeles, California*



*"Microsoft should
have named its DOS 6.0
DOS 5.1."*

THE BILLION-DOLLAR SLUG

In his April 13, 1993, Inside Track column, John C. Dvorak asserts that IBM's AS/400 is "a slug, a joke." My understanding is that the AS/400 is IBM's most profitable product line, generates revenue for IBM that exceeds Digital Equipment Corp.'s entire corporate revenue, and has such advanced features as a relational database system implemented in firmware.

Some slug. Some joke.

*Michael Brodie
Port Credit, Ontario, Canada*

The only statement Mr. Dvorak makes in his April 13 Inside Track that demonstrates the presence of gray matter is that IBM has clung too long to old traditions. He and about two billion other people know this. What he does not know is that deriding the AS/400 for being devoid of innovation and calling it a "joke" makes as much sense as trashing the Stealth bomber because it only comes in black.

The AS/400 is the only multiuser, multiprocessing, 48-bit commercial system on the planet. It can migrate to more sophisticated platforms without a single change to user applications, and no system is more compatible with object-ori-

ented applications than the AS/400 because IBM built it entirely on objects. And according to an IDC study, a network of AS/400s can cost less than an equivalent Novell network because the AS/400's integrated systems software holds down the cost of managing the network.

*Mark Fleming
Carlsbad, California*

CHEATERS NEVER PROSPER

I read "Graphics Accelerators: Waking Up Windows" (April 13, 1993), and I think it's too bad that Hercules and Number Nine wrote their video drivers to optimize Winbench figures, but I can understand their frustration. I've tested a number of video boards using Winbench, and this test suite is not an accurate indication of real-world performance. Why does your test repeat the same short string for text display? Why not a 64K text file with different sizes and fonts? And why have a test score that's enhanced by bitmap caching when you admit that the real-world benefits are slight? Give us a video test for the best all-around real-world performance.

*David Perrell
Woodland Hills, California*

• PC Magazine Labs is working on a test suite called Winstones that will emulate a real-world computing environment. The new test, which will consist of 12 Windows applications performing the way you use them (as determined by a user poll) will be available in the fall.—Ed

GRAPHIC DISAPPOINTMENT

I'm disappointed in your April 13, 1993, review of graphics accelerators. It only covered ISA and EISA boards; where were the Micro Channel boards? Many Fortune 500 companies buy IBM and nothing else. You should review boards for every architecture. I'm willing to bet that there are more Micro Channel systems in use than EISA systems.

*Michael Simmons
Houston, Texas*

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LETTERS

SMB, NETBEUI, NDIS: NETWORKING ALPHABET SOUP

In the April 13, 1993, Pipeline column ("Peer-to-Peer Grows Up"), you mention two transport protocols: SMB and NetBEUI. SMB actually stands for Server Message Block rather than System Message Block. SMBs are created by the redirector and are not transport protocol at all. I also feel that the column would have benefited from a mention of NDIS (Network Device Interface Specification) as it relates to peer-to-peer networks. NDIS allows multiple transport protocols to run on single or multiple network adapters so, for example, peer-to-peer networks can talk to computers within their own segment or workgroup using a fast, streamlined protocol such as NetBEUI, or communicate with a larger scale network using a routable protocol such as TCP/IP or IPX.

*Roy Seabourn
Redmond, Washington*

SEPARATING APPLES FROM ORANGES

In the Trends column for April 13, 1993, two disparate topics, "New File Formats" and "Old Mainframe Standard," were treated under the heading "Documents Under Control," leaving readers with an impression that there is something similar between the two topics, when in fact there is a very distinct difference.

Adobe's Acrobat and No Hands' Common Ground are forms of page description languages that describe the layout and appearance of printed material on a page. The ISO Standard Generalized Markup Language (SGML) describes the structure of a document independent of its layout, so there is no provision for conveying layout information in SGML. Wherever SGML talks about structure and format, it describes features of the document's architecture rather than its appearance. In an SGML application, a document's appearance is not conveyed by the SGML file, it is controlled locally.

*Herman R. Silbiger
Tinton Falls, New Jersey*

LOVE THOSE HARD DISK PARTITIONS

I appreciated your explanation of hard disk partitions (Solutions, April 13, 1993), but you kept implying that partitions were inconvenient. I set up at least two partitions to make things more convenient. On drive D: I install all the software, including DOS. On drive C: I set up data subdirectories. Now when users back up drive C:, they don't have 20MB to 50MB of programs to copy. The only problem is, now DOS 6.0, OS/2, NetWare Lite, and others want to use drive C:. I wish software companies would be less restrictive in where they want their software.

*"Please don't ask me
for illegal copies of
software. I paid for
my software, and I'd
be glad to recommend
a store where you
could buy a copy."*

With my setup, you don't have to know a D: drive exists.

*Allyn Uptain
Chipley, Florida*

IMPROV IS JAVELIN IN LOTUS'S CLOTHING

Wouldn't a more appropriate name for Lotus Improv be Javelin for Windows? Using *new* to describe Improv is misleading since most of its "innovations" (plain-English variables, set-oriented formulas, and so on) were pioneered by Javelin Software, whose product you named one of the best of 1985 (*PC Magazine*, January 14, 1986). Are royalties in order?

*Geoff Waters
Winnetka, Illinois*

FOXY

I found your review of FoxPro for Windows (First Looks, April 13, 1993) to be misleading. User-defined windows in FoxPro for Windows lack horizontal and vertical scroll buttons/bars. You make the Transporter sound like the greatest

thing since sliced bread, but fail to highlight that it only works on code that was previously built with its screen-builder tools. You also omit the fact that operational library routines in FoxPro 2.0 are unavailable in the Windows product.

*A. James Nelson
Toronto, Ontario, Canada*

A WORD FROM THE WISE

I'm frustrated with friends and acquaintances inviting themselves to copies of my commercial software. When I want a program I shop around, save money, and buy the software. I think I need a sign to hang near my PC at home and at work that says, "Please don't ask me for illegal copies of software. I believe it's wrong to distribute illegal copies of software. I'd appreciate your cooperation by not putting me on the spot. I paid for my software, and I'd be glad to recommend a store where you could buy yours. Thank you."

*Michael J. Matthews, Jr.
Smithville, New Jersey*

CORRECTIONS AND AMPLIFICATIONS

In our April 27, 1993, evaluation "Sound Boards: Coming of Age," we incorrectly reported that the Alpha Systems Cyber Audio Card used the Sierra ST8003 chip set with 512K of ROM holding the Aria Synthesizer sound library. The board actually uses the Sierra ST8004 chip set and supports a 1MB sound library.

In our April 27, 1993, evaluation "GUI Communications Software: Simple or Simplistic," we listed an incorrect toll-free number for Software Corporation of America, makers of TalkThru for OS/2. The correct number is 800-966-7722.

HOW TO WRITE TO PC MAGAZINE

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1991



1992

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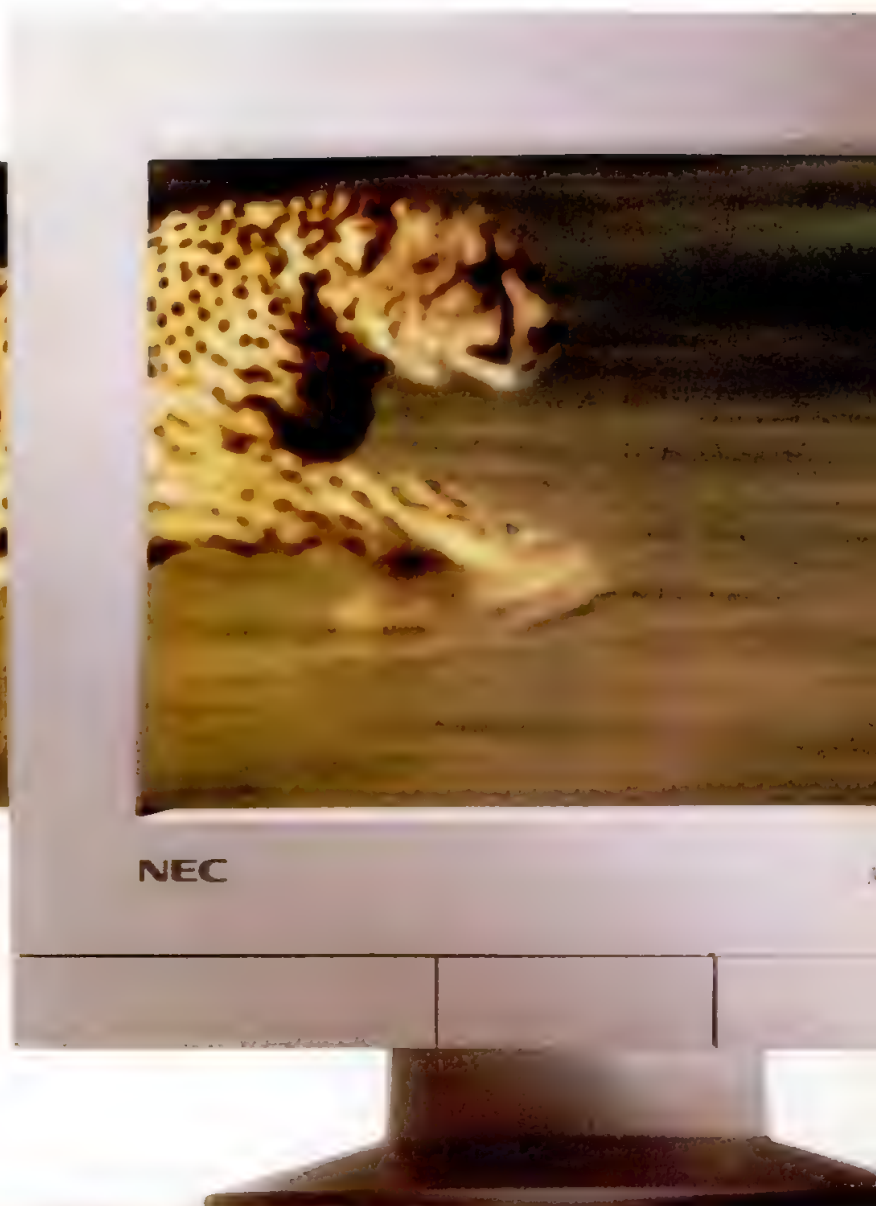
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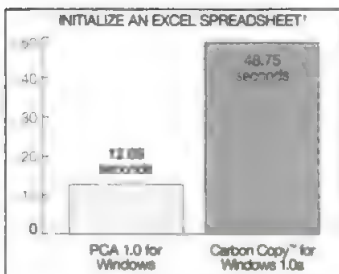


Point. Click. Ta-da,
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pcANYWHERE™ 1.0 for Windows. What's remote computing? Quite simply, it means taking control of your desktop PC from a portable (or another PC). And pcANYWHERE makes this easier than ever.

That's because it's designed especially for Windows, so it has a highly intuitive interface based on easy-



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A new idea from Peter Norton, the leader in utilities software.

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Tested on 486 PC, 4MB RAM. *Option 1, document 435. *Suggested retail price. Actual price may vary. Valid in the U.S. and Canada only. For more information in Europe, call 31-71-353111. In Australia, call 612-879-6577. In Canada, call 1-800-465-2266. Everywhere else outside U.S., call 408-252-3570. Windows is a trademark of Microsoft Corporation. Other names are trademarks of their respective holders. ©1993 Symantec Corporation.

Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

The Fight for Your TV Set

PC and TV firms pick their allies.

Personal computer companies want your TV. After spending more than a decade trying to convince home users to buy beige boxes that extend the work day, PC hardware and software makers are finally begin-

ning to understand that the information appliance most likely to engage the elusive home market is the ubiquitous boob tube. To get control of your television set, companies are infiltrating your house by land, by air, and through the front door.

The companies on the attack read like a soap-opera synopsis. Sega is in bed with cable giant Tele-Communications. Microsoft and Intel have been seen out together and have recently added General Instruments to the ménage. Hewlett-Packard is dancing with TV Answer, and Silicon Graphics is rumored to be talking to Time Warner. And everyone is hot for 3DO.

The terrestrial assault is the strongest because a cable company's wiring can provide the bandwidth to pump in buckets of video. Microsoft and Intel are partnering with General Instruments to create a 386-based cable converter that is, in essence, a computer. Using Windows as the interface, the converter will have the power to let you surf through 500 channels. A dedicated graphics accelerator and digital decompressor will process incoming analog and digital signals. Local memory will let you store limited information, such as each

user's channel preferences.

Silicon Graphics—the company that made the computer behind the special effects in "Terminator 2: Judgment Day"—is reportedly developing a converter for Time Warner's cable division that would transmit digital movies from Silicon Graphics-based video servers. Not to be left out, Apple, Kaleida Labs, Kodak, Philips, and Tandem are working with a consortium known as First Cities to develop advanced cable technologies and products that will run on the fiber-based data highway. Sega has signed a deal to send games over a cable 24 hours a day.

The fastest route to your TV may be through the front door. If you have children, chances are you have a Nintendo or Sega game player attached to your TV, but CD-ROMs will make gigabytes of software playable through Tandy's VIS, Philips's CD-I, and both Nintendo's and Sega's CD-ROM players. The biggest hype will be for 3DO's Interactive Multiplayer, a \$700 CD-ROM system with 3D graphics and animation set to debut this fall. Tell your kids to start saving their allowances now.

—Christopher Barr



Plug-and-Play PCMCIA Cards

AS SOME OF THE PROBLEMS THAT have plagued PCMCIA cards begin to be solved, such as availability and interoperability, manufacturers anticipate an explosion of the credit card-size cards and slots, which are expected on portable and desktop systems alike at Fall Comdex.

"You can expect full-fledged plug-and-play PCMCIA peripherals by the end of the year," says Stephen Harper, strategic planning committee chairman of PCMCIA and executive vice president of Ventura Micro. Right now, card makers are forced to write individual drivers to interface with each notebook's BIOS and firmware. "But BIOS manufacturer Award has completed its universal software interface, which automatically recognizes and configures any PCMCIA peripheral using the PCMCIA's Card and Socket Services 2.0 specs," explains Greg Paley, vice president of engineering at Award. Notebooks that incorporate the interface are expected later this year, and end users who already own PCMCIA notebooks will be able to buy it separately.

One unresolved issue is how to develop 32-bit bus-mastering extensions to the PCMCIA spec to yield faster, more powerful peripherals. The Card Bus Working Group is exploring whether 68 pins can handle 32-bit bus throughput, especially at such high system speeds as 66 MHz.

Another looming issue is power management, says Spencer Kirk, chairman and CEO of portable modem maker Megahertz. As portable devices become low-voltage, maintaining compatibility between cards used in both desktop and laptop environments will get tougher.

For now, manufacturers are focusing on delivering the many PCMCIA cards promised for this fall. Popular features will include modem, LAN, hard disk, flash memory, sound, and multifunction. Specialized cards are expected to provide Data Encryption Standard, Global Positioning System, and handwriting recognition capabilities. —Oliver Rist

Pipeline By Robin Raskin

Usability Wars

If you thought features wars were rough, stay tuned for usability wars. At least features are tangibles you can tick off on a checklist. Measuring the usability of a product is a much more elusive issue. I can't remember the last time a software vendor showed us a product and didn't showcase the company's usability efforts. Nearly every one of the major developers is claiming a dedicated usability lab to validate the effort.

Grilled further, their usability studies turn out to run a gamut of methodologies: everything from pointing a video camera at a user and recording facial expressions to surveys or questionnaires, to interviews, to input from technical support, to recording keystrokes and mouse clicks.



In an impressive show of resources, Microsoft Corp. regularly sends selected users "Instrumented Versions" of Excel and Word. These special versions track which commands get used and in what order. The software gets returned to

Microsoft for analysis. Lotus defines usability as "users' perceptions of a product's ease of use" and emphasizes time-to-task studies. For example, the company recently pitted Software Publishing Corp.'s Harvard Graphics and Microsoft's PowerPoint against its own Freelance and measured how long it took to do operations such as Title Pages and Charts.

Vendors are amassing a wealth of anecdotal and statistical evidence that drives development of their user interfaces and fea-

tures. "Watching a videotape of a user interacting with your product can be excruciating," says Maurice Hamoy of Inset Systems, who compares watching users navigate menus to watching a horror movie that he's already seen. He recalls, "You know they're heading for big trouble. You want to be able to yell at them no, no, don't go in there. You'll never get out." Hamoy says that Hijaak Pro, scheduled for release this summer, uses the Hijaak engine but has a totally revamped UI in response to many hours of "video-watching." Other vendors are making equally radical changes based on usability findings. Fifth Generation Systems is chucking the UI in FastBack, Version 3.0, and returning to an earlier design—one that seemed to be better understood by the users.

And usability does not necessarily mean looking at a single product. Microsoft's usability studies help drive its product synergy strategy. The company has developed 40 core cross-application scenarios, both to improve the integration and consistency of the apps and to change the software development process. The general direction is to move away from a paradigm organized by individual products (the Excel team) to one organized by cross-product functions (the Charting Team, the Toolbar Team).

Is usability a science? Like all good science, it's best when it's practiced in tandem with art. Can products be compared on the basis of their usability? Yes, it's an element you'll see us addressing more and more in our comparative reviews. After years of watching vendors and trying to keep tabs on their features, it should be a real comfort to know that they'll be doing the watching for awhile. Their attention to how we work is bound to produce products that are more usable.

Robin Raskin is an executive editor of PC Magazine.

Can Susan Lucci Be Far Behind?

LARGE CORPORATIONS ARE TAKING advantage of the growing presence of personal computers to expand their marketing mix. More and more, companies such as AT&T and Buick are asking third-party developers to put product information on interactive disks that they can distribute to dealers or prospective buyers. These information disks act as on-line catalogs, with graphics, product specifications, and even sound. Some even

a PC running DOS and CGA or VGA graphics. Catalogs on disk save companies money because they are easily updated and can disseminate information simultaneously to a large audience. And since they replace paper catalogs, which are continuously discarded, with a reusable medium, they better protect the environment.

The InMar Group (210-733-8999) is one producer of interactive disks; its client list

includes names such as Genicom Corp. and GTE. One of The InMar Group's most recent offerings is a disk developed for Chrysler Corp.'s Jeep Eagle Division. The disk takes PC users on a tour of the car maker's latest line, and comes complete with pictures, option packages, and pricing. A game called PhotoQuest puts you behind the wheel of a Jeep Grand Cherokee in search of wildlife photographs; you need to

exploit the features of your Jeep to traverse the off-road terrain and snap the perfect picture.

Another creator of interactive disks is The SoftAd Group (415-332-4704), which caters to companies including Ford, Goodyear, and MCI. A disk the company has created for Lexmark International has been sent to 20,000 IBM printer dealers for loading on their showroom floors. Along with product information, the disk has an interactive game that pits an IBM LaserPrinter against a Hewlett-Packard printer to see which prints the most, the fastest. The SoftAd Group has also produced a retirement planning guide for Baltimore-based T. Roe Price that prompts you for information and advises you on the best way to invest for retirement.

If you want to create your own interactive catalogs on disk, Curtis Software Corp. (310-320-2451) has a Windows program that lets you do just that. Catalog On Disk for Windows (\$1,995) lets you put together a database of text and graphics and assemble a catalog layout with complete search-and-print capabilities. Catalogs can then be distributed on disks, in compressed format, or on CD-ROMs. —Brad Grimes



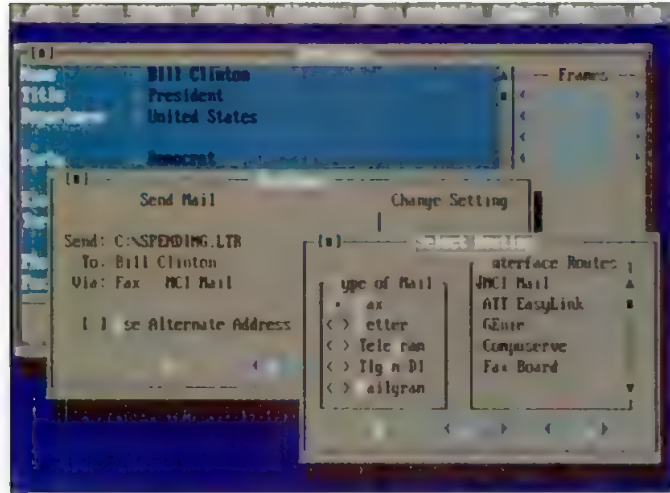
Take an on-disk tour of Chrysler's Eagle Summits.

come with games that make exploring a company's offerings more interesting. All you need in order to leaf through these catalogs is

pricing. A game called PhotoQuest puts you behind the wheel of a Jeep Grand Cherokee in search of wildlife photographs; you need to

Packages Help You Write to Congress

YOU CAN ALREADY COMMUNICATE with President Clinton's office electronically (via America Online, CompuServe, MCI Mail, and other electronic bulletin board systems). Now software programs will let you effectively lobby not only the President, but governors and members of Congress as well.



Contact management software meets database of Congress.

Contact Software International (800-365-0606), makers of the ACT! series of contact managers, is selling Write Your Congressman! (\$39.95), which is based on the vendor's 1stACT! software. It includes profiles of 535 senators and representatives, the President and Vice President, and the Supreme Court Justices, with complete addresses, phone and fax numbers, and committee assignments. You use the program's letter writer to compose letters, memos, envelopes, or fax cover sheets, and when you print the document, Write Your Congressman! logs your correspondence in the contact manager so you can track the progress of your lobbying effort. Registered users receive free, updated databases periodically as elections make them necessary.

Political Systems (800-945-5973) offers Political Action (\$195; \$69.95 for a limited time), a product similar to Contact's Write Your Congressman!, without the contact management functionality, but with a few extra features. Along with all the politicians' names and numbers—including state governors and foreign heads-of-state—Political Action gives you information on important businesspersons and members of the press.

In addition to printing your correspondence, the program lets you transmit your messages electronically over on-line services such as CompuServe, GENie, and MCI Mail, or by fax if you have a fax modem. And if the need should arise, the text of the Constitution and the Declaration of Independence, along with a short guide to political correspondence, are on-line. Political Systems is planning to offer three updates per year; the first will be available free of charge. Subsequent data updates will be available for a fee.

Finally, SoapBox Software (800-989-7627) sells Federal SoapBox (\$129), which resembles Political Action as a tool for generating correspondence without managing your contacts. Federal SoapBox has a graphical flowchart that depicts the chain of command and a wide variety of guides for effective lobbying, including a copy of the Freedom of Information Act, the Privacy Act, and a Guide to Grass Roots Activity. Version 1.1 of Federal SoapBox, due out soon, will provide an MCI Mail

gateway. The price is for a one-year subscription with three updates to the database, and subsequent year-long subscriptions will cost \$49.

—Brad Grimes

PC Prices to Dip

GOOD NEWS FOR 486 BUYERS: PC prices should take another dip later this year. Last year, Advanced Micro Device's loss at a jury trial prohibited the chip maker from shipping 486s using Intel microcode, but a federal judge recently overturned the verdict on appeal.

AMD was the first to break the Intel 386 monopoly in 1991, when it shipped a 40-MHz Intel clone. With competition and added capacity, CPU prices plummeted, and system prices dropped soon after. Immediately after winning its appeal, AMD began shipping 33-MHz, 40-MHz, and DX2/50 486DX clones. These chips are 100 percent Intel-compatible because they use Intel microcode. On tap is a low-voltage (3.3-volt) version of the DX33, which will be

promoted to notebook makers.

During the prolonged trial, AMD claimed to be working on a clean-room version of the 486 that uses microcode developed by AMD. It plans to ship the first clean-room 486s this summer and to roll out new versions of both Intel- and AMD-microcode 486s every few months over the next couple of years. The AMD-microcode and Intel-microcode clones will be indistinguishable from one another. AMD plans to have a Pentium clone available by 1995.

While no systems makers have Am486 PCs on the market, we expect many of the second-tier manufacturers that embraced the Am386 to use AMD to relieve the worldwide 486 shortage.

—Christopher Barr

Top Retail Software

Current ranking	Last issue	Product	Company
1	1	MS-DOS 6.0 Upgrade Kit	Microsoft Corp.
2	—	Ami Pro 3.0 Upgrade Kit	Lotus Development Corp.
3	6	Microsoft Windows 3.1	Microsoft Corp.
4	11	Lotus Improv for Windows	Lotus Development Corp.
5	14	Microsoft Windows 3.1 Upgrade Kit	Microsoft Corp.
6	—	Microsoft Office for Windows 3.0	Microsoft Corp.
7	4	Quicken 2.0 for Windows	Intuit
8	—	CheckIt PRO: Set	TouchStone Software Corp.
9	—	Procomm Plus 2.01	Datastorm Technologies
10	7	QEMM-386 6.0	Quarterdeck Office System
11	8	Quicken 6.0	Intuit
12	—	Excel for Windows 4.0 Upgrade Kit	Microsoft Corp.
13	—	Word for Windows 2.0 Upgrade Kit	Microsoft Corp.
14	—	Windows Draw 3.0	Micrografx
15	—	WinFax Pro 3.0	Delrina Technology

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending April 24, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

PC User Groups Reach Out

FIVE PC USER GROUPS HAVE BEEN named winners of the first annual Awards Recognizing Exceptional Achievement in Community Help (REACH), sponsored by the Association of Personal Computer User Groups and Ziff-Davis Publishing Co., which publishes *PC Magazine*.



The Alamo PC Organization (APCO) won the award for civic and cultural affairs. The Texas-based group lent its computer expertise and support to the organizers of the 1993 U.S. Olympic Festival.

The North Texas PC Users' Group won the education and training award, for sponsoring the Dallas Computer Literacy Program, which serves inner-city dwellers through neighborhood computer labs and school clubs.

In the environment and conservation category, the Boston Computer Society won. The group trained 13 environmental programs to use Macintosh systems.

The PC Clubhouse of Hayward, California, won in medicine and health. The group obtains and maintains equipment for individuals with special needs, and runs a bulletin board for the Disabled Children's Computer Group.

In the social welfare and improvement category, the Columbia Baltimore User Group (CBUG) won. Working with the National Cristina Foundation, CBUG members fix up "surplus" computer equipment and distribute it to disabled and disadvantaged individuals.

Each of the five winning groups receives \$15,000 to continue its outreach program.—*Mary Kathleen Flynn*

Memory Hits a Glass Ceiling

WHILE DOS AND THE INDUSTRY Standard Architecture (ISA) BUS—16-bit technologies found in most AT-class computers today—are comfortable, proven standards, today's memory-rich systems can stretch their limits until they break.

Thirty-two-bit processors have the ability to address 4 gigabytes of memory, so you

YOU PROBABLY RECEIVE SOME NEWS

electronically already, from on-line sources such as Newsbytes on ZiffNet, but what would a fully electronic newspaper look like, and how would you flip through it? To figure out how to gather, filter, and deliver tomorrow's news, the Massachusetts Institute of Technology's Media Laboratory established News in the Future, an international research consortium that includes IBM and publishers Gannett Co., Hearst Corp., Times Mirror, and Tribune Co.

TODAY'S GRAPHICS BOARD BUYERS LOOK

for the highest test scores, but tomorrow's may look for the highest refresh rates, predicts Andrew Fischer, vice president of Hercules. To reduce eye strain, the Video Electronics Standards Association recommends a rate of 72 Hz, but some boards, such as the Hercules Graphite VL, can handle 80 Hz. In Europe, rates of 100 Hz

might assume that if you put 32 megabytes of memory in a 386 or 486 computer, you would have access to all of it. But depending on other elements of your system, you may be disappointed.

For example, let's say you have a 486 computer with an ISA bus, a small computer system interface (SCSI) controller and a CD-ROM drive. To take advantage of the CD-ROM drive, you must load an ASPI manager, such as Adaptec's ASPI4DOS.SYS, along with the CD-ROM. But because of the 24-line addressing of the ISA bus, ASPI4DOS.SYS can only address 16MB of memory. If you attempt to access memory above 16MB—for example, from within a Windows program—the addresses will wrap around to zero, DOS will be overwritten, and your system will crash.

One solution is to trade in your ISA-bus system for a machine with a bus that supports 32-line addressing. The least painful alternative is the Extended Industry Standard architecture (EISA) bus, which maintains downward compatibility with most 8-

and higher are gaining popularity. Unfortunately, most monitors can't accept rates above 72 Hz yet.

DEVELOPERS CONFUSED ABOUT WHICH

CD-ROM standard to support can now produce one disk that will run on several platforms. The \$495 Microsoft Multimedia Viewer 2.0 lets a single title play on Windows 3.1 drives and Multimedia PCs, Sony's Multimedia CD-ROM Player, and the Tandy Video Information System player and other devices based on Modular Windows.

IF YOU'D LIKE TO CONTRIBUTE YOUR OLD

computer equipment to a school but need help with the logistics, call Computers 4 Kids (203-754-5560). Or, if you'd prefer to assist disabled individuals, contact the National Cristina Foundation (800-274-7846).—*Mary Kathleen Flynn*

and 16-bit add-in cards. If you don't mind replacing all your add-in cards, another solution is the Micro Channel Architecture (MCA) found in IBM's PS/2 line of computers. But while MCA offers some real speed advantages, not all add-in cards are available for MCA.

If DOS (or Windows) had memory management features to ensure that the ASPI driver allocated its buffer in the lower 16MB, you wouldn't need to replace your hardware at all. So another solution is to move to an advanced operating system like IBM's OS/2 2.0 or the soon-to-be-released Microsoft Windows NT. Both offer an API to handle the 16-bit bus problem. While NetWare doesn't take care of the memory management itself, its API lets the driver perform the necessary memory management.

And if you're running DOS (or Windows on top of DOS), you may find that your entire system runs more slowly when you have more than 16MB of memory. This is because ROM BIOS shadowing in RAM, with its striking performance benefits, must be disabled. This won't affect performance if you're running OS/2 2.0, Unix, NetWare, or NT because these operating systems don't use ROM BIOS. The bottom line is, if you need more than 16MB of RAM, you should also invest in a 32-bit bus, and maybe even a new operating system.

—*Sheryl Canter*

TRENDS PLUS

You can go on-line to discuss Trends articles and story ideas with *PC Magazine* editors Christopher Barr, Mary Kathleen Flynn, and Robin Raskin in the Trends section of PC MagNet's Editorial Forum. Type GO ZNT:EDITOR from any CompuServe prompt.

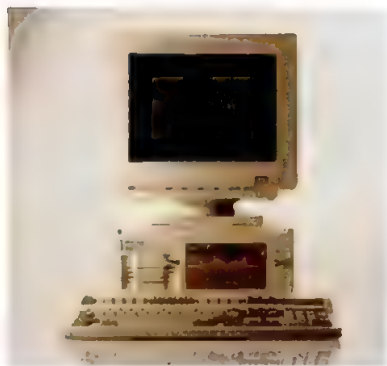
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*Test results obtained by Dell Performance Measurement Lab by running BAPCO SYSmark92, and WINBENCH version 3.11 at 800 x 600, 256 colors. System tested: 486/50 configured with 4MB RAM, 170MB IDE HD, promotions not available in Canada. †Leasing arranged by Leasing Group, Inc. *On-site service provided by BancTec Service Corporation. On-site service may not be available in certain remote locations. MS-DOS and Microsoft trademark of Intel Corporation. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ Mathematical Software

Mathcad 4.0: 32-Bit Power For Ultimate Math Scratch Pad

BY BARRY SIMON

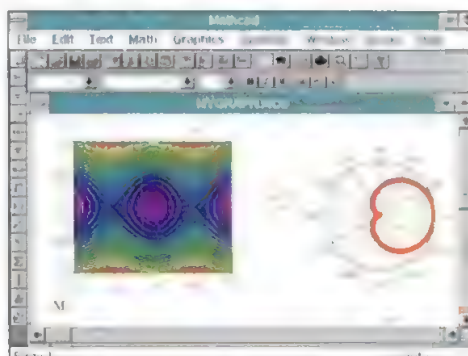
Mathcad, the electronic mathematical scratch pad with the humane interface, has long been popular both in education and in business. The \$495 Version 4.0, the first big update in two years, runs only in Windows' 386 Enhanced mode and is one of the first applications to use the Win32s libraries so that the program runs as a 32-bit app, faster than before.

There are two major advances in the new version of Mathcad. Graphics has long been one of Mathcad's weakest areas, but not anymore. New contour and polar plots have been added, and there is rich

color support for all graph types. Version 4.0 has an intelligent parsing engine called Smart-

maths into Mathcad than you could find in Version 3.0.

There are numerous smaller but welcome changes as well. The familiar toolbar for math symbols along the left side of the Mathcad window is still there, but you'll also find a new toolbar along the top to provide quick access to file open/save, copy/paste, and configuration settings (in Version 4.0, you can cut and paste numbers as data from other Windows



PLOT IT: Mathcad's new graph types include contour and polar plots.

Math that provides much better integration of symbolic mathe-

apps). There is also a ribbon to adjust fonts, boldface, italics, and sub- and superscripts in text regions.

Mathcad 4.0 can be both an OLE client and server, and you can drag and drop equations from one part of a document to another. Maximum document size has grown from 30 to 10,000 pages, and arrays are now effectively limited only by the amount of RAM you have.

POWERFUL SCRATCH PAD

Mathcad provides a WYSIWYG approach to mathematical formulas. If you type a ^, the universal computer symbol for taking powers, you get a superscript on screen so powers look the way they should. Integrals and summations look the way they do in a printed book, but this is not mere fancy typesetting. The formulas are evaluated in place and are live—meaning that if you change the value in an earlier part of a document, the numbers are automatically updated in later parts of the docu-

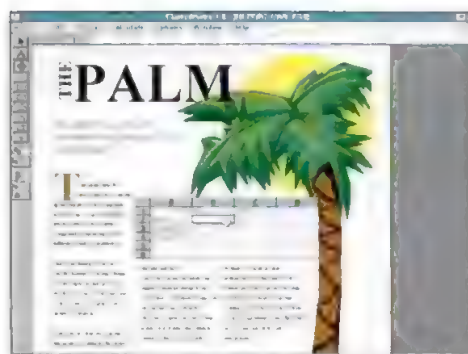
Continues on page 38

■ Integrated Software

ClarisWorks Has a Document Approach

BY GREGG KEIZER

Reports of the death of integrated software under Windows have been greatly exaggerated. While Windows makes big promises when it comes to integrating applications from different vendors—using everything from DDE to OLE—the reality is, even today, far from pretty. But an integrated package that melds major tasks can still find a home under Windows. Notebook users need compact but complete software suites. Small-business and home-office users require full-featured word processing, spreadsheet, and database tools that don't break a



DOCUMENT-CENTRIC: All ClarisWorks' integrated components appear together.

budget. And everyone wants to relearn as little as possible when switching tasks.

Claris Corp. recently moved

its ClarisWorks integrated program from the Macintosh to Windows. It's a good move, for the \$249 ClarisWorks for Windows is a slick composite of word processing, database, spreadsheet, and graphics tools that bests Microsoft Works for Windows.

ClarisWorks isn't just another hodgepodge of disparate apps connected merely by the Clip-

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Mathcad

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ment, just as they would be in a spreadsheet.

The program understands trigonometric and Bessel functions, numeric differential and integral calculus, simple differential equations, curve fitting (including spline fits), and equation solving, and it will easily graph data. Mathcad 4.0's big limitation is that it lacks real programming. The program's two functions, IF and ITERATE, do provide some limited programmability, but for really involved math problems you'll

need to use a program such as Macsyma, Maple, Mathematica, or MatLab.

NEW GRAPHICS POWER

Mathcad has long had two-dimensional plots and introduced simple surfaces in Version 3.0, but this is the first version with a full set of graphing capabilities. Polar plots via parameters have been available before, but now there are explicit polar plots and the tools to create polar axes.

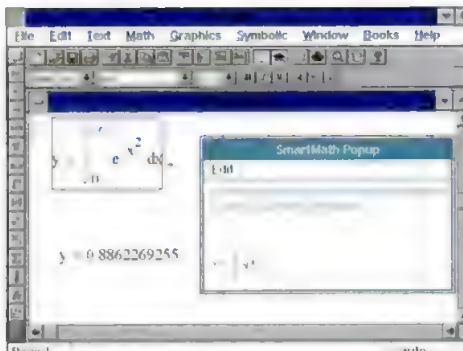
Three-dimensional data can now be presented by contours as well as by surfaces; shifting from one view to the other takes just a couple of mouse clicks. You will also find the kind of great-looking color shading that was first made popular by the Mathematica program.

Despite the progress that Mathcad has made in the graphics area, there are still a few things missing. For instance, you can change perspective in a 3-D plot only by typing in new angles in a dialog box, not by direct manipulation. And Mathcad needs to go beyond the notion of plots as vectors and matrices. It shouldn't be necessary to type in

an explicit discretization of variables. That should be handled automatically in the background.

SMARTMATH

Mathcad has added a rule-based language that interprets equations in the background. Two sets of rules are provided, and more are promised. Both sets



HELPER: SmartMath will first try the Maple engine to do an exact calculation.

involve links to the Maple symbolic engine that Mathcad has licensed since Version 3.0. One set involves optimization of inte-

grals. When this feature is turned on, Mathcad will check if the integral can be done exactly using symbolic math and, if so, it will do it that way and then evaluate the resulting number. This provides greater accuracy and allows the calculation of integrals over infinite intervals for the first time.

Even more convenient is the introduction of a symbolic equal sign, a SmartMath mode that invokes the Maple symbolic engine. This mode addresses one of the major weaknesses of the initial Maple symbolics: They didn't automatically adjust to changes made earlier in a document, so you had to update the entries manually. The new symbolic equal sign is live, so if you change the value of a variable, all later references are automatically updated.

Unfortunately, only some of the Maple symbolics have been carried over to the new live mode. For example, you can do symbolic integrals and factoring, but you can't do symbolic equa-

FACT FILE

Mathcad, Version 4.0

MathSoft Inc., 201 Broadway,
Cambridge, MA 02139; 800-
628-4223, 617-577-1017;
fax: 617-577-8829

List price: \$495; upgrade, \$49.99.

Requires: 4MB RAM, 10MB hard disk space, Windows 3.1 (8MB of virtual memory and math coprocessor recommended).

In short: The slickest math package available is now substantially improved with better graphics and live symbolics.

ON READER SERVICE CARD

tion solving in SmartMath mode. Moreover, the fact that the old symbolic approach still remains means that some symbolic calculations are live while some are not. Confusion can result.

WISH LIST

A few suggestions for Mathcad's next update: Text regions can have color and you can change the overall font, but it would be useful to allow multiple fonts, especially for special symbols and dingbats.

You can't expect Mathcad to provide the thousand-plus functions that Maple has, but we wish that the functions that were provided were more thorough. Polynomials can only be factored over the rationals, not over surds, and Taylor expansions are limited to functions of a single variable.

Highest on our wish list is a revamping of equation editing. We're still uncertain exactly what the Delete key is going to delete when editing. In addition, the current mechanism for selection and entry is so different from the procedures in a word processor that it can be jarring and confusing.

While we can always wish for further improvements, Mathcad is still quite fantastic. It is the ideal tool for any scientist, engineer, or student whose needs don't require extensive programming. □

Mathcad Handbooks

Mathcad 4.0 has special hooks that let you connect invaluable math-related "handbooks" to your Mathcad setup. Mathcad 3.0 started the trend, but its handbooks were merely Windows help files. Mathcad 4.0's handbooks are built as a special kind of Mathcad file that can include Mathcad formulas and graphs.

When you load a handbook, the formula bar to the left side of the main Mathcad window changes to a set of icons that give you quick access to the contents, the index, and the next/previous page. You can open regular Mathcad documents and cut and paste from a handbook into them.

MathSoft provides nine general-purpose handbooks priced from \$69 to \$149 each, five educational handbooks for high school or college students at \$69 each, a Signal Processing Function Pack for \$249, and nine \$99 Application Packs.

General reference handbooks include two collections taken from the famous CRC tables and two from Tyler Hicks's *Standard Handbook of Engineering Calculations*. The only downside to the handbooks is the amount of disk space they consume. The selected tables from the *CRC Handbook of Chemistry and Physics* (including tables of integrals and physical constants of the elements) eat up almost 4MB.

It takes special authoring tools to make Mathcad handbooks; for now, the only ones around come directly from MathSoft. Soon, however, third parties will license the tools and create and sell their own handbooks.—BS

ClarisWorks

CONTINUED FROM PAGE 37

board's Cut and Paste. Rather than call on separate applications—segregated in separate windows—to create a complex document filled with words and numbers, for instance, ClarisWorks shows just one open document. Pound out the words, and when the numbers need to appear, click on a tool to create a spreadsheet frame inside the document.

Other tools build similar frames for graphic shapes, while the menu selections at the top of the document change automatically to stay in sync with the frame under the cursor. This document-centric approach to integration is at the heart of ClarisWorks. Copied from the Macintosh version, it's a logical solution that sidesteps the traditional cut-and-paste or module switching seen in most other Windows-integrated packages.

But interface aside, the ClarisWorks program comes ready to work. Its word processor not only includes the requisite spell-checker and basic editing features but even tosses in several advanced tools, such as linked text frames and multiple columns. Since building graphical shapes on the page is simply a matter of picking the right tool from the palette, the ClarisWorks word processor can also serve as an elementary page layout program. Another nice feature allows direct editing of footnotes and headers on the page rather than within a separate window.

CLICK ON SPREADSHEET

ClarisWorks' spreadsheet has more than 100 functions, as well as the ability to paste those functions from a list. Charting tools

■ Cross Platform: Yes and No

Unfortunately, even though they come from programs that look more alike than different, file sharing between ClarisWorks for Windows and ClarisWorks on the Mac isn't as slick as you'd think.

Documents created with ClarisWorks 1.0 on the Mac can be opened directly by ClarisWorks for Windows, assuming you can get the files to the PC. It's easy enough to carry a 1.44MB floppy disk formatted on the PC to a Mac, have it read by the Mac's SuperDrive with a utility like Apple's own PC Exchange, copy the appropriate files, then head back to the PC.

However, files built by ClarisWorks 2.0 on the Mac can't be opened by ClarisWorks for

Windows; you're forced to save to a generic format such as text, .DIF, or SYLK on the Macintosh and then import the data into a ClarisWorks for Windows document before you can work on it.

The return trip from Windows to Macintosh is even tougher. You must modify the ClarisWorks for Windows file's Creator and Type designators once the files are on the Macintosh. PC Exchange can do this for you automatically, and you can make manual changes with other Macintosh utilities such as ResEdit. A new, recently received update to ClarisWorks should correct this compatibility problem. It arrived too late for testing.—GK

include seven basic styles, from pie and bar to scatter and area, and some of them can appear in 3-D. Formatting is particularly flexible. You can modify font, size, color, and style on a cell-by-cell basis. The spreadsheet is not

during mail-merge operations with the word processor.

The program's drawing tools are little more than basic, but you can dabble with color and patterns, rotate objects in 90-degree increments, and group and ungroup objects. You can also import paint-format images into the application (and thus into any ClarisWorks document).

Conspicuously absent from ClarisWorks is a dedicated communications tool. Instead, the program relies on links to Windows own Terminal. That's sufficient only for infrequent use. ClarisWorks on the Macintosh has a capable communications module; the Windows version should, too.

Thanks to its global interface approach, several important features are available within every environment. You can check spelling, import files, zoom the view as much as 3,200 percent, and record and run macros within any type of document. File importation is especially easy: Any supported file format—from Word for Windows and WordPerfect to .PCX and .XLS—can be inserted into a document simply by dragging its icon from the

File Manager and dropping it into a ClarisWorks window.

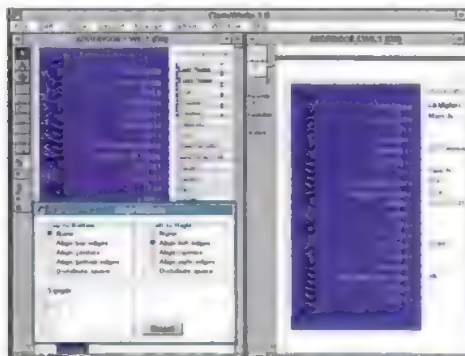
There are some problems that mar an otherwise excellent program. ClarisWorks' WYSIWYG display isn't always true to life. On a test system with a local-bus version of ATI's Graphic Ultra Pro video card at 1,024-by-768 resolution, fonts that were supposedly shown in 100 percent views appeared minuscule instead. And the program has a nasty habit of crashing while working under PC Tools for Windows' desktop.

Even so, ClarisWorks is a tough competitor on the jack-of-all-trades software circuit. Not only can it go head-to-head with Microsoft Works for Windows

feature by feature, but its frame and tool approach to building compound documents is how all integrated packages should work, especially those within Windows.

• List price: *ClarisWorks for Windows, Version 1.0*, \$249 (\$99 until 8/15/93). Requires: 2MB RAM, 3MB RAM hard disk space, Windows 3.0 or later. Claris Corp., 5201 Patrick Henry Dr., Box 58198, Santa Clara, CA 95052; 408-727-8227.

Circle 430 on reader service card



LIKE FILEMAKER: You can view a database in layout and record views together.

huge—its grid is only 500 by 40—but since most users will use it most of the time to insert small worksheets into text documents, that's not a major liability.

The included flat-file database is based on FileMaker Pro, Claris' first Windows title. Building a database is mostly a matter of entering field names and dragging boxes around the screen, a simple task within Windows. ClarisWorks helps the process along by letting you display both the layout and the record view side-by-side for instant feedback as you make modifications. The database also serves as the data repository



From June 14 through June 18, you can go on-line on PC MagNet to download a demo of ClarisWorks for Windows or to discuss the program with Gregg Keizer and Claris product managers. Type GO ZNT:EXEC from any Compu-Serve prompt.

■ Notebook PCs

Canon NoteJet 486: PC and Printer in One

BY JULIE COHEN

Just when you thought nothing else would fit in your briefcase, Canon introduces the NoteJet 486. By combining a high-quality Bubble Jet printer with a 486SLC-based computer, Canon has made printing from a notebook PC a reality.

Slightly bulkier than a standard notebook, the NoteJet weighs 7.7 pounds with its battery and measures 2.2 by 12.2 by 10 inches (HWD). The unit uses a 25-MHz Texas Instruments 486SLC processor and includes 4MB of RAM, an 85MB hard disk, a monochrome VGA display, a trackball, and the necessary printer accessories: one printhead, two ink cartridges, and a detachable paper tray.

With the 85MB disk, the NoteJet sells for \$2,499; a 135MB model (\$2,799) and a 180MB model (\$2,999) are also available. RAM is expandable



ULTIMATE INTEGRATION: There is a printer under the hood of this 7.7-pound PC.

to 12MB using a snap-in SIMM; two PCMCIA 2.0 slots can hold a modem to send or receive data

and plain-paper faxes.

Canon's Bubble Jet BJ-30 gives this notebook its printing ability. Its 360-dot-per-inch resolution produces crisp documents, and the unit supports IBM X24e, Epson LQ-510, and Canon BJ-10ex emulation.

The ink cartridge prints about 65 pages, and replacement parts—a \$43 printhead and an \$8 ink cartridge—bring the price of each page to about 14 cents.

A space under the keyboard doubles as an automatic sheet feeder with room for as many as ten sheets of 8.5- by 11-inch paper. But don't jostle the unit when you're printing; it's somewhat fussy. Twice, while printing a ten-page document, we moved the pages under the keyboard and had to start

again. Print speed is also quite slow: On PC Magazine Labs' Printer Benchmark tests, the system operated at 31 cps—about a page per minute.

The NoteJet 486 performs somewhat better than 386SL systems but not as well as 486SX-based models on PC Labs' Benchmark Tests. Though memory and video scores were about average compared with Cyrix 486SLC/25-based systems, the NoteJet's disk scores were well above average—even better than many 486SX-based notebooks. On our 2-Digit battery test, the NoteJet lasted 3 hours 16 minutes with the printer off.

A well-balanced system, the NoteJet 486's output is as good as its performance.

• List price: *Canon NoteJet 486, with 4MB RAM, 85MB hard disk, DOS 5.0, Windows 3.1, \$2,499. Canon Computer Systems Inc., 123 East Paularino Ave., P.O. Box 5048, Costa Mesa, CA 92628; 800-848-4123, 714-438-3000; fax, 714-438-3099. Circle 431 on reader service card*

■ Notebook PCs

Micro Electronics WinBook Does Windows by Design

BY BRUCE BROWN

Micro Electronics' WinBook gives your wrists a break. The Cyrix 33-MHz 486SLC-based notebook has sufficient CPU power, RAM, and hard disk storage space for moderate Windows applications use, but its best feature is an integral trackball mounted in the middle of an expansive wrist rest at the front of the keyboard.

The WinBook weighs 5.5 pounds with the battery installed, and the AC adapter adds 1.5 pounds. The standard setup, which costs \$1,799, comes with 4MB RAM, a 120MB hard disk, an internal 1.44MB floppy disk drive, an internal fax modem, DOS 6.0, Windows 3.1, and communications and fax soft-

ware. The WinBook has one PCMCIA Type 2 slot and serial, parallel, external VGA, and PS/2-keyboard ports, as well as an expansion port for a docking station with two 16-bit slots and two drive bays (a \$399 option).

The WinBook's 85-key keyboard becomes comfortable quickly as you get used to resting your wrist on the front of the machine and using your thumbs to move the trackball and tap its two buttons. There's no need to move your fingers from their normal positions on the keyboard. It has a responsive feel and it's easy to control the cursor with the trackball.

The WinBook's backlit monochrome passive-matrix LCD screen supports VGA resolution and simultaneous external

1,024-by-768 video. The screen is slightly faster than average, but bleeds noticeably both horizontally and vertically.

The Cyrix CX486SLC/E CPU has a 32-bit internal data path, a 16-bit external data bus, and a 1K cache. Compared with 25-MHz 486SX notebooks with 32-bit internal and external data paths, the WinBook scored below average on processor tests and above average on memory and disk tests (our test system ran IBM DOS 5.02). The nickel hydride battery lasted 4 hours 2 minutes on the Z-Digit test.

The WinBook is recommended for its comfortable and efficient keyboard, trackball, and wrist rest; good battery life; and full complement of equipment

at a good price. The only drawback is the LCD screen.

• List price: *WinBook with 33-MHz 486SLC/E CPU, 4MB RAM, 120MB hard disk, fax/data modem, DOS 6.0, Windows 3.1, \$1,799. Micro Electronics, 1160 Steelwood Rd., Columbus, OH 43212; 800-468-2162, 614-481-7460; fax, 800-448-0308. Circle 427 on reader service card*



FRONT AND CENTER: WinBook features an ideally placed trackball.



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Sound Boards

Logitech Sounds Off with Inexpensive 16-Bit Board

BY WINN L. ROSCH

Designed to be the noisemaker for your favorite games and the source of aural entertainment, the Logitech SoundMan 16 gives voice to your PC with no pretenses of higher purposes.

By trimming features, the SoundMan 16 earns an aggres-

sive price, the lowest among its major competitors. Listing for \$289—compared with the \$349 charged for Creative Labs' Sound Blaster 16ASP and Media Vision's Pro Audio Spectrum 16—Logitech expects a street price under \$200.

Like its competition, the SoundMan 16 board uses FM

synthesis based on the 20-voice, 4-operator Yamaha OPL-3 (YMFM262) chip. Its sound digitizing abilities extend to full CD quality, 44.1 kHz sampling 16-bits deep in stereo. It also supports disk-saving lower sampling rates (8, 11, 22, and 32 kHz), 8-bit depth, and mono sound.

Game-playing shows the SoundMan 16 at its best, adding the impact and quality of 16-bit audio to all games that follow the Sound Blaster standard (which means nearly all modern games). The SoundMan 16 also provides facilities for manipulat-

ing sounds taken from files or from its three hardware inputs—microphone and auxiliary inputs on the rear panel and a variety of CD connections on the face of the board.

The 7-inch, 16-bit board is based on the Media Vision 16 chip set and includes a 15-pin game port that can support a MIDI connection (with an optional kit). A single stereo output on the rear panel, backed with 4 watts per channel, will drive either speakers (powered or not) or headphones.

Missing from the SoundMan 16 is a connection, proprietary or SCSI, to control a CD-ROM player. In that most third-party CD-ROM players include their own SCSI adapters, this small omission need not be a major shortcoming. Moreover, the SoundMan 16 does include inputs that allow direct audio connection to most CD-ROM outputs for playback and sampling.

Logitech adds only essential software to the SoundMan 16 package. Included are two Windows programs—Pocket Recorder and Pocket Mixer—for capturing, editing, enhancing, and auditioning audio. From the DOS prompt, SoundMan 16 utilities allow recording and playback of .WAV files and let you control the sound quality and mix.

Setup of the SoundMan 16 is handled entirely through software, using an installation program that sets the board's interrupt and DMA assignments with instant testing to confirm positive results. While this configuration software works well, the Logitech Windows utilities sometimes slipped out of control when confronted with DOS 6 on a DoubleSpace-compressed disk.

•List price: *Logitech SoundMan 16*, \$289. Requires: 640K RAM (2MB recommended), speakers or headphones. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500.

Circle 404 on reader service card

Multimedia

\$399 Pro MovieSpectrum Captures Motion

BY GREGG KEIZER

If you want to create, not just watch, video-in-a-window movies on the desktop, you need a capture board that can transform analog images on tape or disk into an understandable data stream. And if you want to do that on a budget, you can't ignore Media Vision's \$399 Pro MovieSpectrum, an inexpensive but still quite capable video grabber for the PC.

Like almost any hardware add-on, the Pro MovieSpectrum is most intimidating during its installation. Depending on your current system setup, you may need to change jumpers and shove DIP switches on the board itself or make manual modifications to your CONFIG.SYS file or Windows' SYSTEM.INI files.

The Pro MovieSpectrum captures video from either an S-Video or a composite video source, and even includes an RS-422 port for video devices that can be controlled from the computer. To connect a typical household camcorder to the board, for instance, you simply stick an RCA-style plug into the board's composite jack. Pro MovieSpectrum doesn't include on-board audio input (as does Creative Labs' \$495 Video-Blaster) so you'll need a separate sound card to weave pic-

tures and sound into a single clip.

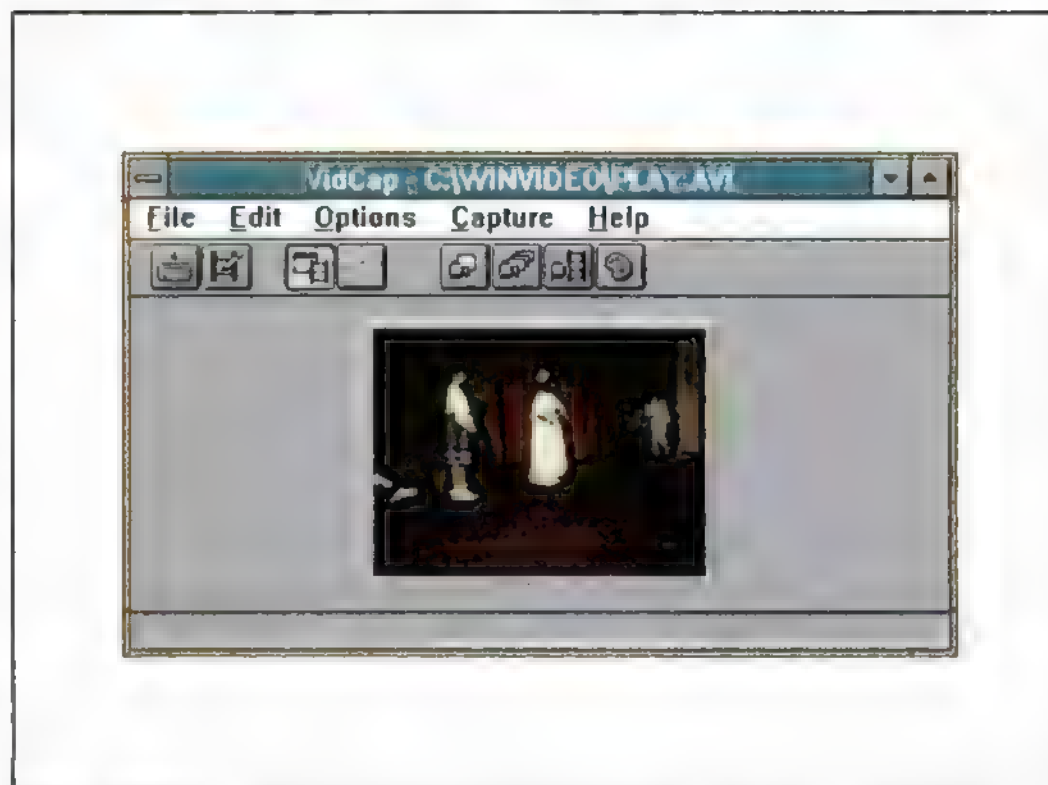
In place and linked to an outside video source, the Pro MovieSpectrum depends on the included copy of Microsoft Video for Windows to capture and edit your movie masterpieces. The board can grab running video in only two tiny sizes—80- by 60-pixel or 160- by 120-pixel frames—but it can snap a single static screen as large as 640 by 480 pixels. Recording rates are closely tied to your system's processor and disk-transfer speeds, but this card can capture video as fast as 30 frames per second (fps). On a 33-MHz 486 test system with 8MB of RAM and a 240MB hard disk, however, it couldn't

do better than 15 fps without dropping out frames.

Though video produced by the Pro MovieSpectrum is postage stamp-size, the quality is acceptable for run-of-the-mill multimedia. It may lack such extras as on-board audio and real-time clip compression, but its low price and software tools make it an excellent choice for anyone who wants to make movies on a shoestring.

•List price: *Pro MovieSpectrum*, \$399. Requires: 4MB RAM, Microsoft Windows 3.1 or later, one 16-bit expansion slot. Media Vision Inc., 3185 Laurelview Ct., Fremont, CA 94538; 800-348-7116, 510-770-8600.

Circle 409 on reader service card



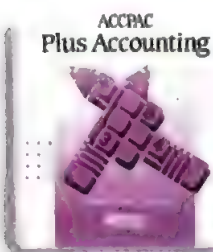
SMALL SCREEN: The largest video window is 160 by 120 pixels.

"I'm no idiot. I can see that 3,000 visitors a day at \$10 a head adds up. I can only imagine how much they make from food sales and other stuff like those life-size posters of yours truly. All I ask is that they take good care of all the money that I'm working so hard for."

*Name: Magilla
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Salary: All he can eat plus free health and dental
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5-Year Average Annual Growth: 75%
Software: ACCPAC® Plus Accounting™
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Make darn sure we never run out of bananas."*



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Windows Database

CA-dBFast 2.0 Turns Database Projects into Windows Apps

BY STEPHEN W. PLAIN

Among all the choices in today's database market, Computer Associates' CA-dBFast (\$550) is aimed squarely at the Xbase developer who wants to migrate applications to Windows. Compared with Microsoft's FoxPro 2.5 for Windows (\$495, plus \$500 for a distribution kit), CA-dBFast, Version 2.0, offers a more affordable though less sophisticated alternative for distributing Windows Xbase applications.

Long in the making, this release of CA-dBFast upgrades features, not performance. CA has solved most of the problems that plagued earlier versions and has added some powerful—and some not-so-powerful—development tools. However, the program offers little to lure the non-programmer or those looking for an object-oriented development tool.

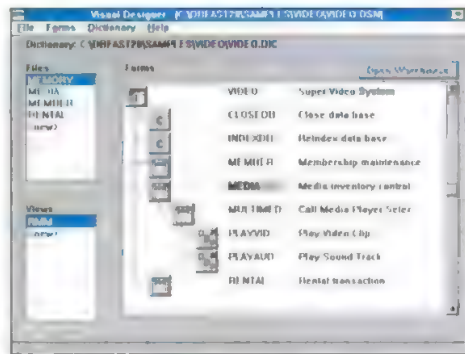
Rooted in the dBASE III PLUS language, CA-dBFast offers total compatibility only with dBASE III Plus and near-compatibility with Clipper Summer '87. Code written in Clipper 5.x and dBASE IV may or may not transfer smoothly, depending on how the code takes advantage of language extensions. Any existing dBASE code will run unchanged as a Windows app and take advantage of controls such as buttons, combo boxes, and radio buttons that CA-dBFast provides as part of its language.

VISUAL DESIGNER CHALLENGE

One of the biggest enhancements to CA-dBFast is the Visual Designer, a graphical tool meant to speed up application development. While it's a quantum leap forward for CA-

dBFast, it still has a long way to go to achieve the power and ease of use expected from a Windows development environment.

The Visual Designer is built around the Design Tree, a chart of connected icons that repre-



VISUAL DESIGNER: A necessary addition.

sent the structure of your application. From this level, you add windows, menus, reports, and code. But each time you add a new piece, you must launch an editor for that design object and then return to the design tree.

This back and forth approach makes the design process awkward and prevents you from working on multiple parts of your program from one central view. For example, you cannot define the menu for a window from the window editor. Instead, you must return to the Design Tree and launch the menu editor. Also, basic features such as a design grid associated with pixel coordinates (the current one is fixed and based on character height) and the ability to copy objects are absent from the window editor.

Usability issues aside, the Visual Designer does help to get Xbase Windows applications off the ground. One of its better features is a customizable ASCII "action" file that contains a list of commonly used code snip-

pets. This file is used by the Visual Designer to present you with a combo box list of code pieces for quick association with controls.

After laying out controls on forms and attaching code, you se-

lect the Generate Application option to produce the .PRG source code. From there, traditional coding and compilation can take place from the Workbench. The generated source code is well formatted and structured around CASE statements to react to the events corresponding to the Windows controls you created.

CA-RET REPORTS

The next major enhancement is CA-RET, Computer Associates' core reporting engine, which offers a very fluid, visual environment for creating tabular, form-based, label, form letter, or freestyle report formats—covering just about any reporting need. The Visual Designer and CA-RET may be contrasts in usability, but the more tedious and frustrating chore of designing reports is made simple by CA-RET.

The CA-RET runtime module generates reports that you can run standalone or trigger transparently via DDE from a dBFast application. It also lets you define a query interactively through dialogs that prompt you for conditions, columns, tables, and sort orders.

One convenient feature is the SQL button that pops up the SQL equivalent of the query for editing. As the query evolves, a

browse window of the query result is updated in real-time.

APPLICATION DEVELOPMENT

Of all CA-dBFast's development features, the best is the royalty-free distribution of compiled applications and reports. You can produce .EXEs from within CA-dBFast's integrated development environment and distribute them for free. FoxPro for Windows requires an additional distribution kit for royalty-free runtimes.

Among other new features is a "#DEFINE" preprocessor directive that lets you define constants, and an "&&&" command, which, when placed in front of a line of code, will execute that line in CA-dBFast but treat it as a comment if the source is interpreted by dBASE. The improved debugger now provides single-stepping and a variable watch window.

Computer Associates is planning a maintenance pack that will address many of the remaining usability problems. But the improvements in Version 2.0 make CA-dBFast a viable tool right now for quick ports of Xbase code to Windows. With some improvements to the Visual Designer, it could eventually regain its standing in the now-crowded Windows database market. □

FACT FILE

CA-dBFast, Version 2.0

Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY 11788; 800-225-5254, 516-342-5224

List price: \$550; upgrade, \$99
Requires: 2MB RAM, 7MB hard disk space, Windows 3.0 or later.

In short: An integrated development environment for Windows database applications, CA-dBFast has strong tools for migrating Xbase projects to Windows. Usability quirks of the Visual Designer need to be worked out.

ON READER SERVICE CARD



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■ Pen PCs

IBM Upgrades Pen Line With ThinkPad 710T

BY BRUCE BROWN

With flexibility as the central design theme, IBM's second-generation pen device, the ThinkPad 710T, is smaller, lighter, and less expensive than the earlier 20-MHz 386SX-based ThinkPad 700T.

The ThinkPad 710T comes with IBM's 25-MHz 486SLC CPU and 4MB of RAM (expandable to 12MB). The

700T supported only GO Corp.'s PenPoint; this unit supports both PenPoint and CIC Corp.'s PenDOS.

Two versions are available: a File model for use with IC memory cards, and a Hard Disk model. The \$2,999 ThinkPad 710T File model can use 5MB, 10MB, and 15MB memory file cards (\$649, \$1,099, and \$1,499, respectively), but no cards are included in the list price. The

File model has three Type 2 PCMCIA slots, two of which can hold one Type 3 card. The Hard Disk model costs \$3,599 with



WRITE ON: The ThinkPad 710T has three Type 2 PCMCIA slots.

PenDOS or \$3,699 with PenPoint. This model has only one Type 2 slot but includes a 60MB hard disk in the price. At 5.7 pounds with the battery, the 1.5- by 11.75- by 9.5-inch (HWD) Hard Disk model is about 0.3 pounds heavier than the File model.

BACKLIT PANEL

The 9.4-inch monochrome passive-matrix LCD panel (640-by-480 resolution) has an etched glass cover, which provides a fairly natural feel when you write with the cordless digitizer pen. This surface treatment is the same as the 700T's and is superior to that of most other pen systems, which feel slippery in contrast. The pen fits conveniently into its own pen garage on the side of the pen computer.

Though the screen is backlit, using the system in its reflective mode will conserve some power. You should expect a bit more than 3 hours of battery life with backlighting turned on, or close to 4 hours without. Brightness and contrast are adjusted by tapping buttons on the edge of the screen; the backlighting control is in the same place.

You can also plug an external monitor into a standard VGA port on the side of the 710T. Other ports accommodate an external floppy drive (not included), parallel printer, serial device, and PS/2 keyboard and mouse.

Its many technical improvements and lower price probably won't cause you to run out and buy a ThinkPad 710T based on the technology alone. Horizontal applications are lacking and handwriting recognition, while improving, is still acceptable only for limited use. Still, the 710T is a good current technology machine to use for pen application development.

•List price: *IBM ThinkPad 710T* with 4MB RAM, 60MB hard disk, PenPoint, \$3,699. IBM Personal Computer Co., Rte. 100, Bldg. 3, Somers, NY 10589; 800-426-2968.

Circle 426 on reader service card

■ Desktop Publishing

\$59.95 PagePlus 2.0 Has Surprising Power

BY JAMES KARNEY

Serif's PagePlus, Version 2.0, has a lot going for it. This \$59.95 Windows-based desktop publishing program has features found in packages retailing for ten times its price. You get WYSIWYG drag-and-drop layout, style templates, a table editor, import filters for major word processing and graphic file formats, color separation support, and a slick user interface. Add another \$40 and you get a font pack, clip art, and a type special-effects editor.

PagePlus 2.0 uses the same pasteboard metaphor found in Version 1.0. You place objects directly on the page by using the program's text and drawing tools or by importing them from other applications. Then you use the mouse to resize and manipulate them. The controls are very intuitive. We had no problem creating a three-page newsletter without referring to the manual. The tools and options change when

you switch between text and graphics work.

The new version overcomes two problems of Version 1.0: the lack of stylesheets and the inability to place tabs in text blocks. You can now use templates to create master pages, and samples are included.

Text handling is greatly improved, and you can still edit either in a text window or directly on the page. Text blocks either run free on the page or are set in frames that can be used to form

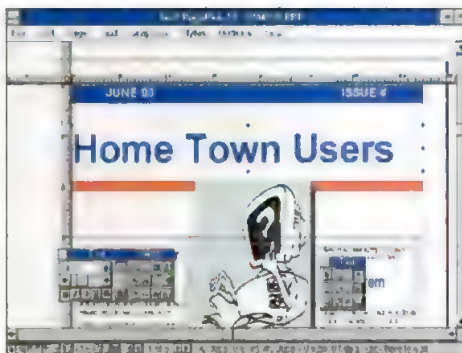
columns, color accents, and cut and paste from an Excel worksheet, without difficulty.

The layout tools are far better than you'd expect to find in a bargain package. Rulers move anywhere in the workspace, and both the rulers and user-defined guidelines serve as snap points. We used them to align text and graphics to each other, making precise placement a snap. PagePlus also handles text wrap around irregular shapes without difficulty.

Of course there is more to desktop publishing than words. PagePlus has basic drawing tools for circles, lines, and boxes. You can import common bitmaps and formats, or paste using the Windows OLE commands. The program supports 24-bit images and Pantone colors. With a PostScript-compatible device, you can create color separations, but not with the advanced controls found in more robust applications.

•List price: *PagePlus, Version 2.0*, \$59.95; with *TypePlus, ArtPack, and FontPack*, \$99.95. Requires: 2MB RAM, 3MB hard disk space, Windows 3.1. Serif Inc., P.O. Box 803, Nashua, NH 03061; 800-697-3743, 603-889-8650; fax, 603-889-1127.

Circle 429 on reader service card



PAGE DESIGN: PagePlus has strong layout tools.

columns and to jump a block from one page to another.

The table editor is like a spreadsheet with the text controls of a draw program. We were able to produce a complex table with varied rows and

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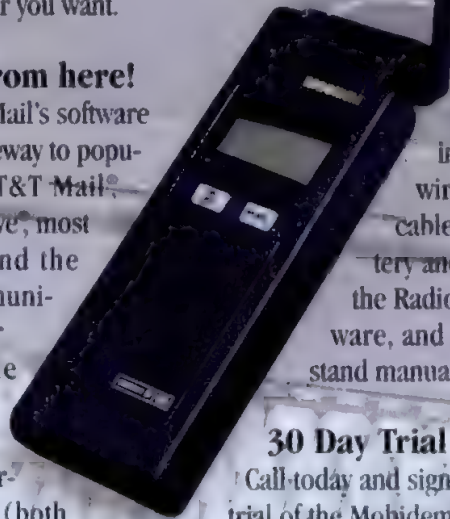
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RadioMail

■ Spreadsheet Add-ins

Evolver 2.0: A Darwinian Approach to Excel Problems

BY CRAIG STINSON

Excel Inc.'s Evolver 2.0 is a \$695 optimizing add-in for Microsoft Excel that, like nature itself, relies on time, trial and error, randomness, and tests of fitness to find optimal solutions.

Although Excel is bundled with its own Solver, Evolver can handle complex resource-allocation problems, such as finding which product mix generates the highest profit while meeting specified supply constraints. Unlike Solver, which uses a numeric method of problem solving (the generalized reduced gradient method), Evolver employs a "genetic" algorithm.

To begin a search for the best solution, you supply fitness tests in the form of Excel formulas. The program repeatedly samples the entire population of possible solutions at random and lets each trial's best outcomes "mate" to produce better results. For example, if a solution involved x, y coordinate pairs, the fittest x 's from each iteration

would be paired with the fittest y 's. Eventually, an optimum solution would emerge.

Like Darwinian evolution, Evolver allows for crossovers and mutations. The crossover rate determines the likelihood

will include random values.

Evolver offers two advantages over Excel's Solver. First, because its methods don't depend on measuring the rates of change between successive iterations, Evolver can't be fooled by local optima. Therefore, Evolver is better suited for problems that involve many discontinuities, such as problems involving lookup tables.

Second, Evolver includes options for solving combinator-

number of unequally sized packages into a set of identical containers) and "traveling salesperson" problems (find the shortest path between a set of cities).

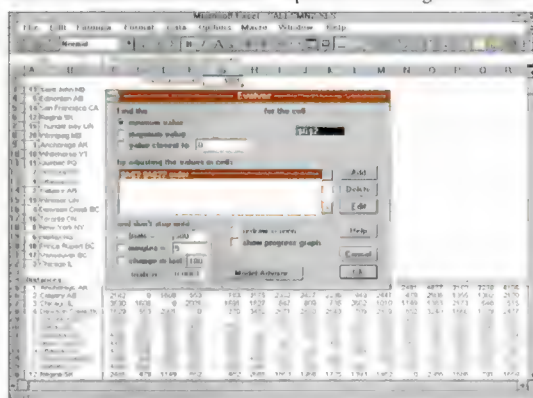
As in nature, problem-solving by natural selection is time consuming. To solve complex problems, you should have a 486 (or a fast 386 with a math coprocessor) and run it overnight. While Evolver is busy, you can't use Excel, but you can use other Windows programs.

Evolver is a dynamic link library called from an Excel add-in macro. But it comes with a documented application programming interface you can call from any programming language. If you use it from Excel, be aware of one peculiarity: It will ask for your serial number every four months and lock you out if you fail to provide it.

At nearly one and a half times the price of Excel, Evolver is an expensive add-in. But if you're now relying on guesswork, a mainframe, or a consultant, it'll earn its keep overnight.

• List price: *Evolver 2.0*, \$695. Requires: Microsoft Excel 3.0 or later, math coprocessor highly recommended. Excelis Inc., 4668 Eastern Ave. North, Seattle, WA 98103; 206-632-0885.

Circle 408 on reader service card



EVOLUTIONARY: Evolver's "genetic" algorithm solves problems.

that future solutions will include values returned by earlier solutions. The mutation rate is the probability that future solutions

will include random values. You can use it to tackle "bin-packing" problems (find the least wasteful way to stuff a large

■ Mass Storage

Silicon Valley IDE Mirror Card: Safety in Numbers

BY BILL TROOP

Disk mirroring is one good way to make data backup worries disappear, and Silicon Valley Computer's \$195 IDE Mirror Card, an ISA-bus mirroring controller, is an inexpensive way to do it. Using RAID 1 technology, the card (model ADP104) takes two identical or closely matched standard IDE hard disks and pairs them up as active backups of each other. The card gives any PC true disk mirroring—data written to one is automatically written to the other, too.

With your data safely on two hard disks, the failure of either one won't put you out of action. You don't even have to reboot if one fails. Because the mirroring technology is built into the hardware, it works with all operating systems, with no degradation in hard disk performance.

The IDE Mirror Card lets you connect one or two pairs of mirrored IDE hard disks—that is, up to four individual drives—to your PC. It can also operate as an ordinary IDE controller or allow a mix of one mirrored pair and a third individual drive.

There are some minor drawbacks. For example, should a drive fail, the only immediate indication is a 40-second slowdown while the controller shuts down the defective drive. If you don't notice, you won't know that one of your drives has failed until your next cold boot. Then you'll get a warning beep and a diagnostic screen. Silicon Valley also builds a terse utility into controller ROM that reports the status of your system and rapidly copies files from one drive to another should you need to reformat or replace one of the mirrored drives.

Also, at present the system has trouble with Windows 3.1 32-bit disk access should you want transparent recovery. When 32-bit disk access in

Windows is enabled and a drive fails, you'll have to reboot. Without 32-bit disk access, Windows keeps on running if a drive fails. Silicon Valley expects to have this glitch fixed soon.

The likely dangers this card can't protect against are data loss from fire or theft. If you want the greatest possible data security with the least possible effort, the IDE Mirror Card provides it.

• List price: *Silicon Valley IDE Mirror Card*, \$195 (\$245 for model ADP108, with a floppy controller allowing any combination of four drives, including 2.88MB floppy disk drives). Silicon Valley Computer, 441 N. Whisman Rd., Bldg. 13, Mountain View, CA 94043; 415-967-1100; fax, 415-967-0770.

Circle 407 on reader service card

■ OS/2 Programming

New Borland C++ Builds 32-Bit OS/2 Applications

BY SHERYL CANTER

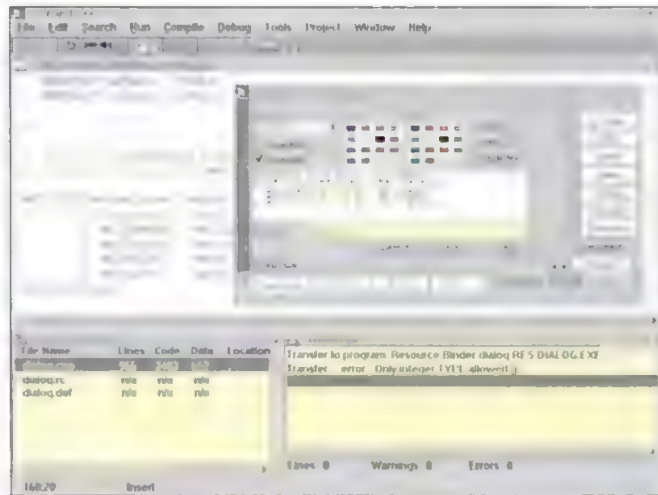
Priced at \$495, Borland C++ for OS/2 (BC++ for OS/2) provides all the essential elements you need to produce 32-bit Presentation Manager (PM) applications. Its object-oriented development environment takes full advantage of the OS/2 Workplace Shell (WPS), and the new graphical debugger lets you debug PM applications without leaving the environment. The package comes with extensive on-line help, including full documentation of the C language and the PM API.

BC++ for OS/2 does not come with some of the high-quality tools found in the Windows version of the product. Most significantly, there is not yet an OS/2 version of Object Windows Library (OWL), Borland's application framework. Although it's in the works, Borland says the first 32-bit port of OWL will be to Windows NT;

the OS/2 version won't be released until some time after that. There is no profiler or class browser. The profiler presents technical problems under OS/2, but a class browser is planned for the next release.

clicking on an icon with the mouse.

Some changes were made to take advantage of the WPS. For example, the multi-level Options menu has been consolidated into a WPS notebook



SETTINGS NOTEBOOK: Configure your development environment.

ONLY FOR OS/2 2.0

BC++ for OS/2 lets you write state-of-the-art, 32-bit programs for OS/2 2.0, but it doesn't let you write 16-bit programs for any operating system, not even OS/2 1.x. The programs you write can be libraries or executables in text or graphics mode, but they must be 32-bit. You can call 16-bit library functions from within your programs, but you must write a "thunk" in assembly language to do so. Turbo Assembler for OS/2 is included in the package.

If you are familiar with BC++ for DOS or Windows, you already know how to do most things in BC++ for OS/2. As with the other editions of BC++, there is support for precompiled headers, project files, and color-syntax highlighting. A speedbar lets you access the most frequently used menu options by

object, greatly easing navigation. And like the rest of OS/2, the IDE is object-oriented. You can click on almost anything with the right mouse button and obtain a context-sensitive pop-up menu.

Context-sensitive help is available by pressing F1. To bring up the syntax for any C command, you need only place the cursor on the command in the editor, and press Ctrl-F1. Hypertext links in the help screens allow you to move easily from topic to topic. But you'll need a magnifying glass in order to read the screens if you're running in high resolution (1,024-by-768).

Complete on-line documentation for the PM API is supplied with the package. It's the same documentation that's included with IBM's C Set/2 (and it doesn't suffer from the

tiny text problem). However, context-sensitive help for the PM API cannot be accessed through Ctrl-F1.

STRONG DEVELOPMENT TOOLS

Borland's powerful built-in editor supports unlimited Undo/Redo and is configurable through the Settings notebook. The Turbo Editor Macro Language lets you define custom key bindings. An integrated debugger is supplied in addition to the full-featured standalone debugger, Turbo Debugger GX. Both are graphical, so they can exist on the desktop together with your application as it executes. An OS/2 version of Borland's well designed Resource Workshop provides visual tools to create icons, bitmaps, dialogs, menus, and more.

The IDE supports background compilation by launching a separate thread of execution, so you can do other things while waiting for your application to build. Like the DOS and Windows versions of BC++, the compiler is globally optimizing and implements the latest C++ standard—AT&T CFRONT 3.0—including nested classes and templates. Though exceptions are not supported, you can watch for operating system exception messages from within the debugger.

If, despite its convenience, you don't want to use the IDE, there is also a complete set of command tools. You can even use BC++ for OS/2 within IBM's Workframe/2; the necessary language profile and DLLs are provided.

BC++ for OS/2 brings the powerful Borland compiler technology to the OS/2 2.0 platform with a state-of-the-art IDE and a graphical debugger. The multithreaded, object-oriented development environment supports mixed-mode programming and takes excellent advantage of the Workplace shell. BC++ for OS/2 is a strong entrant into the OS/2 compiler market. □

FACT FILE

Borland C++ for OS/2

Borland International, 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-0877, 408-438-8400; fax, 408-439-8088

List price: \$495

Requires: 4MB RAM (8MB recommended), 20MB hard disk space, OS/2 2.0 (installation of OS/2 service packs such as Service Pack XR06055 is recommended)

In short: Borland C++ for OS/2 provides all the essentials to produce 32-bits OS/2 2.0 applications. There is extensive on-line help, including full documentation of the C language and the PM API

401 ON-READER SERVICE CARD

■ SCSI Adapters

Future Domain PowerSCSI Connects Peripherals

BY JAMES KARNEY

Installing a new CD-ROM drive or scanner may be out of the question if you're short on space for add-in cards. If this sounds familiar, you should consider connecting peripherals to your PC with a Small Computer System Interface (SCSI) adapter. With one SCSI host adapter, you can connect up to seven devices—hard drives, CD-ROMs, tape units, scanners, and printers.

Until recently, SCSI devices were difficult to install, but Future Domain's two new PowerSCSI kits—the SCSI CD-ROM and the SCSI ValuePaks—offer easy, budget-based hardware and software starting at \$69.

Both kits feature Future Domain's new PowerSCSI software. Since DOS and Windows don't offer built-in SCSI support, hardware vendors have to provide special drivers that are linked to other drivers tuned for a specific host adapter. Most drivers are based on one of two methods. Adaptec's ASPI (Advanced SCSI Programming Language) is the most popular approach. Future Domain and NCR use the Common Access Method (CAM).

PowerSCSI is a universal application interface that supports ASPI, CAM, DOS Int13 (hard drive BIOS support), WinDisk, and CD-ROM drivers with any supported Future Domain host adapter. As a result, the cards in the kits will work with almost any driver module on the market. There's also direct operating system support via CAM for LAN Manager, NetWare 386, OS/2, and SCO, Interactive, and USL Unix.

The SCSI-2 16-bit TMC-1680 we tested ran a Micropolis hard

drive, two floppies, a Toshiba CD-ROM, a Panasonic optical drive, a tape unit, and an HP printer. Installation was fairly easy. We just set the jumpers, ran the installation program, then manually added the third-party drivers to CONFIG.SYS. Performance was acceptable.

■ Word Processors

XyWrite 4.0: Essential Upgrade for Loyalists

BY EDWARD MENDELSON

XyWrite 4.0 remains true to this classic word processor's command-driven, character-mode ancestry while adding graphical and menu-driven features that bring it into the 1990s. XyWrite's primary audience remains writers and publishing professionals, who value its use of pure ASCII files and its high-speed, no-frills style of entering and editing text.

This \$495 package—the first version released since The Technology Group took over the original developer last year—retains most of XyWrite's speed and increases its already incredible customizability. It also improves the WYSIWYG editing and drop-down menus that the program acquired when an earlier version was codeveloped by IBM and shipped under the name of Signature 1.0. Users of either Signature or XyWrite III Plus can upgrade to XyWrite 4.0 for \$99.

A keystroke now switches between XyWrite's command line and a drop-down menu line. The command line lets you recall earlier commands, and a new customization feature lets you program your own commands or replace built-in commands. You can also rewrite the menus and create context-sensitive help screens, although the

procedure is far more difficult than in Windows word processors. Formatting commands are still stored in codes that display as triangles.

You can switch between text mode and an editable WYSIWYG mode that uses Bitstream Speedo fonts for text display with another keystroke. XyWrite imports PCL, .PCX, and TIFF graphics, although the process is slow and awkward. You can display files in graphics

mode on the same screen with files in text mode. The new version also adds conveniences such as one-key-stroke transpositions of characters, words, sentences, and paragraphs, and the ability to store the cursor position and screen location of up to nine files.

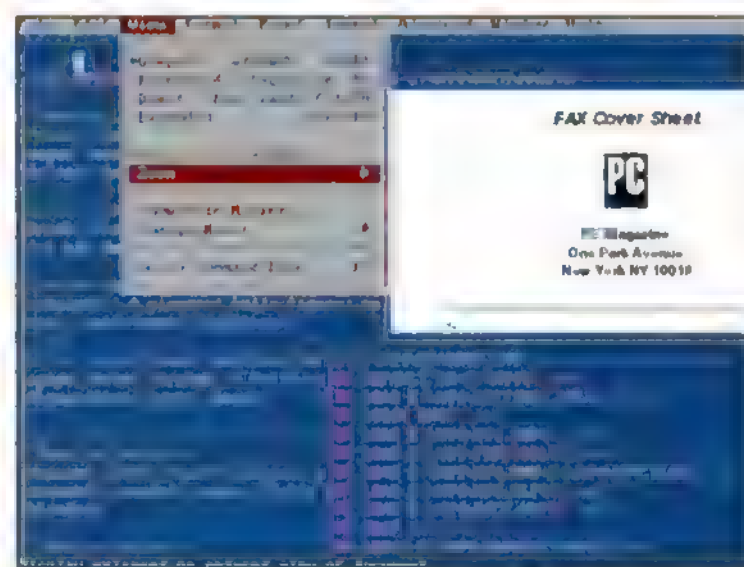
A feature dropped from earlier versions, but now restored,

Circle 425 on reader service card

automatically expands abbreviations or corrects your most common spelling errors as you type. The program imports files in major word-processing formats, but if you neglect to specify the import format manually, your documents get littered with nonsense characters.

XyWrite 4.0 is faster and more logical than Signature, but slower and more awkward than Nota Bene, also from the Technology Group. Nota Bene is also

derived from XyWrite III Plus but isn't slowed down by graphics functions and has even richer editing features. Although XyWrite can no longer fit on a 360K floppy disk, its new conveniences make it an essential upgrade, even for diehard loyalists of the



GRAPHICAL: XyWrite 4.0's text and graphics.

mode on the same screen with files in text mode.

The new version also adds conveniences such as one-key-stroke transpositions of characters, words, sentences, and paragraphs, and the ability to store the cursor position and screen location of up to nine files.

A feature dropped from earlier versions, but now restored,

XyWrite command line who hate the mere idea of graphics and menus.

• List price: XyWrite, Version 4.0, \$495, upgrade \$99. Requires: 384K RAM, 2MB hard disk space, DOS 3.3 or later. The Technology Group, 36 S. Charles St., #2200, Baltimore MD 21201; 410-576-2040; fax 410-576-1968.

Circle 424 on reader service card

While the competition plays catch-up, Borland continues to lead with the most graphical C and C++ for Windows, DOS, and OS/2.

CIRCLE 287 ON READER SERVICE CARD

■ Presentation Graphics

Compel: Jazz Up Slide Shows With Multimedia Effects

BY MARK BROWNSTEIN

The days of the boring presentation are coming to an end. Asymetrix Corp.'s \$295 Compel, a powerful though not always easy to use tool for creating presentations and integrating multimedia components into them, can add spice to your shows.

Like most presentation graphics products, Compel is designed around a slide show metaphor. To create a presentation, you simply design individual slides. The program is very flexible, and there is a broad array of tools to use to create interesting and entertaining presentations.

You start by selecting from among dozens of slide show templates. The predesigned templates give you a wide variety of backgrounds that are suited to many different kinds of presentations, plus settings for font style, size, and color. Although you'll probably find a template that works well for you, you can always modify an existing template or create your own.

Bullets call out major points in your presentation, and an Autobuild feature automatically creates a new slide based on each bullet item. Slides support 16 levels of bullets, and their order and position are adjustable.

Slide and bullet transition effects can jazz up a single slide or an entire slide presentation. Fades, wipes, spiral effects, and other transitions help to create a presentation that keeps the audience's interest.

Compel also includes a "hot-word" feature that connects words to objects. Click on a hot-word or bullet and you can

launch a sound file or any other multimedia element.

A built-in charting application lets you choose from a variety of chart styles for displaying graphical data. You enter the data for the chart in an included spreadsheet. Fortunately, you can also import data from another Windows app. The charting tool is also OLE-ready. When linked, Compel reads the data from the linked file and produces the chart based on current data. This could be very valuable in situations where real-time data reporting is crucial.

SIMPLE ANIMATIONS

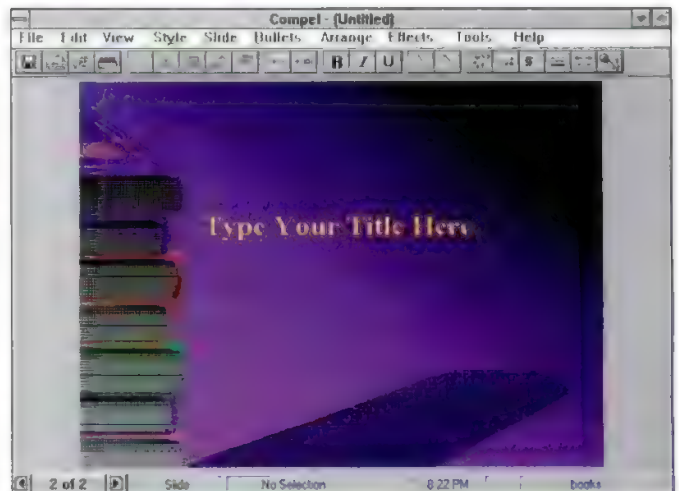
Compel also has a simple animation program. To create an animation, you select a graphic on your slide and define its starting point, its end point, and its size. Once linked to a bullet or other element, the animation will play during your presentation.

Compel's capabilities go far beyond these basic links. Multimedia elements, including Autodesk Animator .FLC and .FLI files, .WAV audio, and

inside a Compel presentation.

Slides can also launch other applications, and you can even run slide shows you create with Asymetrix's MediaBlitz!

Compel's interface is fine for creating simple slide shows, but it's harder to use when you try to



PREDESIGNED: Compel's templates get you off to a good start.

link objects and add multimedia effects. Once you get past the moderate learning curve, however, Compel is relatively easy to use. Clever features, such as the TwinClick navigation tool that lets you jump directly to any slide when you click on both mouse buttons, help the nervous presenter.

A presentation packager and runtime driver included with Compel make it easy to take your slide show on the road. Compel compresses the slides, moves the linked images and other multimedia files, and copies them to removable media. Links to data using OLE can't be copied when the linked data is not accessible, so data current at the time you package the presentation is

included. When you're going to run a presentation on an unfamiliar PC, the system's ability to display the multimedia objects is checked in order to avoid any surprises when its time to run the show.

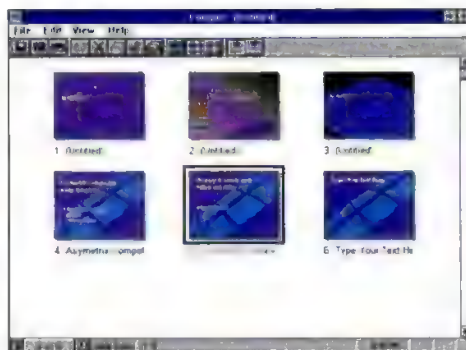
Compel debuts in a field that has become increasingly crowded. Popular presentation products such as Freelance Graphics, PowerPoint, and Harvard Graphics have new multimedia elements, and recent entries from Corel Corp., WordPerfect Corp., and others are nudging their way in. For a limited time,

Compel is available for \$99. At this price, MediaBlitz!, which has a comparable list price, is included at no charge. Compel's inclusion of a substantial library of clip art, animations, digital video, and sound files on a CD-ROM raise the stakes in the presentation software features war.

Even if you only do a few presentations a year, Compel will make it easier for you to create stand-out presentations with whatever level of multimedia sophistication you choose to apply.

• List price: *Compel, Version 1.0*, \$295 (\$99, through July 10, 1993). Requires: 2MB RAM, 6 to 12MB hard disk space, Windows 3.1. Asymetrix Corp., 110 110th Ave. NE, #700, Bellevue, WA 98004; 800-4486543 206-462-0501; fax, 206-455-3071.

Circle 402 on reader service card



SLIDE VIEWER: Preview and reorder slides.

Microsoft Video for Windows (.AVI) files will play when launched from a slide. With appropriate driver support, live video and CD Audio (played on a CD-ROM drive) will also play

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■ Color Printers

\$1,699 HP DeskJet 1200C Sets New Color Ink Jet Standard

BY ALFRED POOR

Take a look at this print sample. The colors are so smooth and vivid that you might think the output came from a thermal transfer page printer. It didn't. It's from Hewlett-Packard's new DeskJet 1200C ink jet printer. With a show-stopping \$1,699 list price, the 1200C rivals printers that cost three times as much.

In some respects, the 1200C is closer to HP's PaintJet line than to other DeskJets. The DeskJet 550C uses two ink cartridges: one black, and one with cyan, yellow, and magenta inks and print nozzles. The PaintJet XL300 uses four separate cartridges, one for each ink color. The 1200C is like the PaintJet XL300; both are PCL 5 page printers, formatting each page in memory before printing. But there are differences, too. The DeskJet 1200C's list price is half that of the PaintJet, and at 29 pounds, the 1200C is about a third lighter.

LASERLIKE SPEED

Not only is the 1200C affordable and compact, it's also fast. The 1200C's results on PC Magazine Labs' Printer Benchmark tests show laser-printer-like speed. Under PCL, the 1200C churned out text at a 7.0 page-per-minute clip. The 1200C has many quality settings that affect graphics speed, but the results for our monochrome test image ranged from 3.0 graphics pages per minute at draft mode to 0.6 gppm at the highest quality glossy paper settings. Chalk up some of this speed to the 1200C's support for HP's new high-speed parallel port

design, which allows faster data transfers from computer to printer.

The printer also comes in a 1200C/PS version (list price \$2,399) that has support for PostScript Level 2. Under PostScript, the text speed dropped to 3.9 ppm in default mode and 5.3 ppm in fast-speed mode. Graphics times ranged from 0.59 to 1.1 gppm. The printer lets you send PostScript and PCL print jobs without reconfiguring between jobs.

Output quality is outstanding. The 1200C produces 300-dpi resolution output and has a 600-by-300 resolution enhancement feature that improves text quality. There were a few isolated incidents of horizontal banding on some test print samples, but the vast majority showed even ink coverage and vivid color saturation—especially when using the special coated paper that came with the 1200C. Since this paper costs about a dollar a sheet, you wouldn't want to use it for text

HP estimates that the per-page operating costs of the 1200C are some of the best in the business. Thermal page printers have the same cost per page no matter how much ink is transferred to the sheet. Ink jet costs per page vary with how much ink is used, and HP estimates the 1200C pages range in cost from about 2 cents for a typical page of text to about 50 cents for 100 percent coverage of a page with black and colored ink.

The 1200C is simple to set up and operate. The ink cartridges are easy to install, and there is a simple purge procedure that's designed to clear any clogged jets. The ink cartridges also have an indicator that changes color when the ink level gets low. There is a 180-sheet input paper tray, but a vertical manual-feed slot in the back of the 1200C makes it simple to feed single sheets of special stock or envelopes.

The printer takes the same modular I/O expansion cards as the LaserJet 4 family (the 1200C/PS comes with an AppleTalk module standard). You can add memory to the standard 2MB (4MB for the 1200C/PS) up to a maximum of 26MB (20MB if you have PostScript installed.) The basic model comes with 45 scalable Intellifonts and TrueType fonts. The PostScript option adds the standard 35 PostScript fonts as well.

CALIBRATED OUTPUT

Also included are Windows 3.x drivers for PCL 5 (and for PostScript, if you get the 1200C/PS or the PostScript upgrade). The PCL 5 driver lets you calibrate the output to match

your computer monitor's screen settings. You look at some patterned images on the screen and make adjustments to them in response to screen prompts. You can then choose to print using either default settings, screen-matched settings, or "more-vivid-than-the-screen" settings. This provides excellent control over the saturation levels of color output under Windows.



AMAZING OUTPUT: The best color ink jet results yet.

etched species is in the well-trodden se who are showing **Bold Italic Compre**

SHARP: Text looks good too.

The DeskJet 1200C may be the breakthrough product that will eliminate the painful choice between color support and quality text output. If you're in the market for a new printer, and you think you might someday want to use a little color in your printed output, now is the time to consider an ink jet instead. Consider the HP DeskJet 1200C.

• List price: *HP DeskJet 1200C*, \$1,699; *DeskJet 1200C/PS*, \$2,399; *Adobe PostScript Upgrade Kit*, \$729; *black ink cartridge*, \$29.95; *colored ink cartridges*, \$34.95 each. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051; 800-752-0900; fax, 800-333-1917.

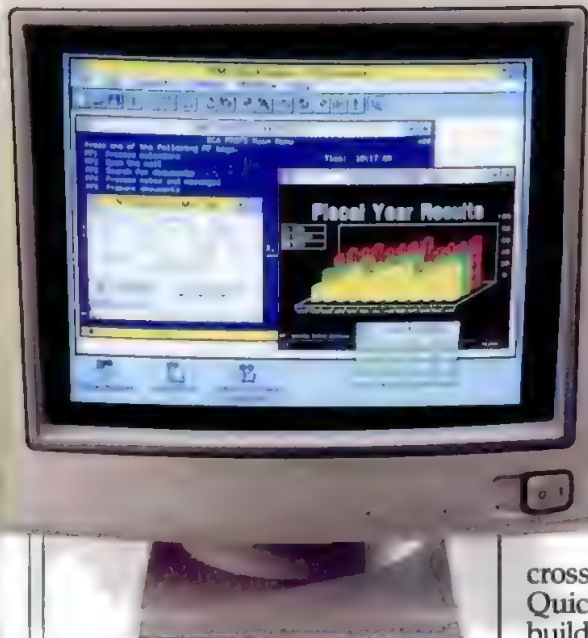
Circle 432 on reader service card



COMPACT DESIGN: The 1200C is smaller than the thermal printers it competes with.

documents, but the 1200C also handles plain paper just fine. Even under magnification, it would be easy to mistake the results for laser printing.

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CIRCLE 651 ON READER SERVICE CARD

■ Graphics Software

Stanford Graphics 2.1 Lives Up to Its Potential

BY ROCK MILLER

3D Visions has always wanted Stanford Graphics for Windows to be the universal analysis and presentation toolkit for technical professionals. Now, in Version 2.1, this \$495 program finally begins to live up to its promise.

Version 2.1 covers little new ground, but it represents a major improvement in usability and reliability. One awkward aspect of the interface, for instance, has been cleaned up by intelligent use of the right mouse button, which greatly speeds the formerly tedious job of setting the numerous chart attributes. You can now customize graph default characteristics more easily, and the ability to rotate TrueType fonts for axis labels is welcome.

Version 2.1 is also much more flexible in its use of spreadsheets and graphs. You can now create a chart more easily from an open data sheet, and you can change the style of an existing chart. The bugs that marred Version 2.0 are largely cured, and the program's screen performance is noticeably better.

These small but significant improvements finally unleash Stanford Graphics' potential as a tool for exploring your data graphically. Its huge selection of 2-D and 3-D technical and statistical charts offers many ways to visualize your data, and its advanced analysis tools include adjustable histogram and box-whisker statistics, cyclical curve fitting, data smoothing, and spline interpolation, as well as regression-based curve fits.

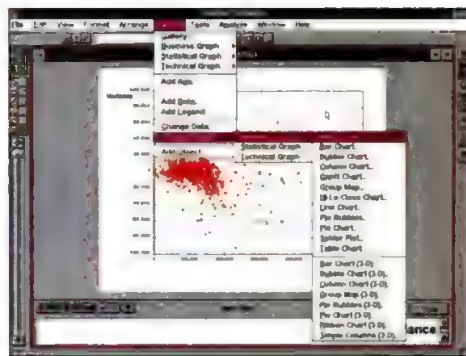
The results are dumped into multilayered data sheets for further manipulation. Thanks to named variables and in-cell formulas with statistical functions, complex transformations are a

snap. It supports both client and server data links, so you can feed curve-fit residuals or histogram parameters to your Windows spreadsheet and link the results into Stanford Graphics for charting. This flexibility makes up for the lack of sorting or row exclusion within the data sheet.

The program doesn't fare as well as a presentation tool. Minor improvements don't make up for the basic awkwardness of its master, outliner, and

word charting facilities, nor for its limited artistic tools. The dimensions and aspect ratio of your presentations are still tied to the printer driver, and the screen show is minimal. Yet in practice these limitations may not matter: Stanford Graphics embeds charts into other Windows programs smoothly via OLE.

• List price: *Stanford Graphics for Windows, Version 2.1*, \$495. Requires: 2MB RAM, 13MB hard disk space, Windows 3.1.



TECHNICAL: Stanford's improved charting.

4MB RAM and math coprocessor recommended. 3D Visions, 2780 Skypark Dr., Torrance, CA 90505; 800-729-4723, 310-325-1339; fax, 310-325-1505.

Circle 406 on reader service card

■ Mass Storage

Iomega's Floptical Drive: 21MB on One Disk

BY AMARENDRA SINGH

Considering the ever-increasing demand for hard disk space for today's applications, users are always on the lookout for bigger storage solutions. Iomega, maker of high-capacity Bernoulli disk drives, offers one promising answer with its new Iomega Floptical PC Powered drive. Priced around \$399, this 3.5-inch drive uses optical technology to pack up to 21MB of data on a removable floptical disk.

The Floptical PC Powered drive offers easy-to-access mass storage at a reasonable cost (about \$1 per MB, after the initial cost of the drive itself) and the flexibility of a regular 3.5-inch disk drive. It's read/write compatible with all popular disk formats, including a 21MB format suitable for backups.

Installing the drive and controller card is simple. An installation disk interrogates your system and tells you how to configure the jumpers on the card. After you insert the card

and connect the drive, the installation program copies all drivers and utilities onto your hard disk and modifies your CONFIG.SYS and AUTOEXEC.BAT files automatically. The model we reviewed was an external unit that did not require its own power supply. Iomega



DIGI BYTE: Not your typical floppy drive.

quires a proprietary utility, the syntax is similar to the DOS FORMAT command.

In transferring data from the hard drive to the Floptical disk, the unit was more than satisfactory. Floptical disks in Floptical drives transfer data faster than a standard floppy disk drive, but slower than a hard disk drive. A standard 3.5-inch floppy disk used in the Floptical drive transfers data no faster than a floppy disk in a floppy drive.

With a street price around \$399 and Floptical disks costing about \$20 each, the first 21MB will be the most expensive. The subsequent incremental cost of \$1 per MB is about equal to the cost per MB of standard floppy disks.

The 21MB Floptical disk format may prove to be an excellent solution for your data storage. Although tape-backup units still offer lower-cost data storage, the ease of use and performance of the Iomega Floptical drive more than make up for any additional cost.

• List price: *Iomega Floptical PC Powered*, \$399. Iomega Corp., 1821 W. 4000 South, Roy, UT 84067; 800-777-6179, 801-778-1000; fax, 801-778-3450.

Circle 403 on reader service card

plans to offer an internal version that you use as a plug-in replacement for any standard 3.5-inch drive.

In our informal tests, our system read and wrote standard floppy disks in both double- and high-density formats using both the Iomega and standard floppy drives. Although formatting on an Iomega Floptical drive re-

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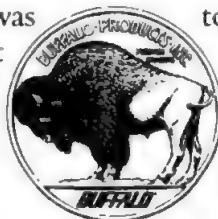
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Our top-of-the-line, Buffalo SL was their performance choice. It also just happens to be the best value on the market.

And although the SL is loaded with state-of-the-art features, including full Windows compatibility, you don't have to be a rocket scientist to use or install it.

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CIRCLE 328 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

IMPROVED

Fastback 6.0 Looks Familiar

The 6.0 in **Fifth Generation Systems'** Fastback Plus 6.0 corresponds to the latest DOS offering from Microsoft and represents a leap back to the future. After a variety of tests, users told Fifth Generation that they liked the backup program's older, more simplified interface, so the vendor complied. Fastback 6.0 also offers virus detection, enhanced tape drive support, and new network functions. Now you can back up tape drives across networks and administrators can schedule unattended backups.

- List price: *Fastback Plus, Version 6.0*, \$149. *Fifth Generation Systems Inc.*, 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-365-3186, 504-291-7221; fax, 504-295-3268. Circle 412 on reader service card

NEW

Texas Instruments Makes Its Marc with New Ink Jet Printer

After successfully launching its microLaser and microWriter families of printers, **Texas Instruments** has announced that it will enter the rapidly growing ink jet market with its new microMarc ink jet printer. The microMarc uses a 128-nozzle drop-on-demand thermal print engine to produce 300 dots per inch at a rate of 300 characters per second. It includes PCL 3 printer emulation, three resident font families (Courier, Dutch SWC, and Letter Gothic), and a 100-sheet automatic paper feeder.

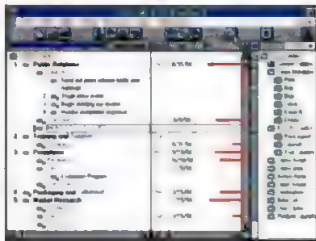
- List price: *T1 microMarc*, \$419. *Texas Instru-*



Texas Instrument's \$449 microMarc printer.

ments Inc., P.O. Box 202230, ITG-302, Austin, TX 78720-2230; 800-527-3500, 817-774-6660. Circle 411 on reader service card

HOT PROSPECT



Arabesque Brings Outlining to Personal Information Managers

Arabesque Software's ECCO Professional represents a new frontier in Windows-based personal information managers (PIMs). The group at Arabesque has taken the benefits of a database-oriented PIM and combined them with an outline-oriented thought processor/decision facilitator. Now your data is cross-referenced and integrated so you can see any and all of your information, from your appointment schedule to your contact histories, in a context of your choosing. Arabesque calls ECCO a SuperPIM, because in addition to everything you'd expect in a PIM—calendar, phonebook, to-do lists, import/export capabilities, and DDE, OLE, and e-mail support—it includes a universal outliner for putting all your information in a variety of views; a proprietary database technology for organizing information and displaying relationships among data; and a feature called Shooter, which makes it easy to move information into ECCO from other applications. Across networks you can have shared folders and outlines (later this year, a workgroup version will include group scheduling and shared calendars), and for laptop users, it's RAM-based so it accesses the hard disk less often and saves battery power.

- List price: *ECCO Professional*, \$395 (\$99 for a limited time). *Arabesque Software Inc.*, 2340 130th Ave. NE, Bellevue, WA 98005-4244; 206-822-8172.

Circle 410 on reader service card

IMPROVED

IBM's New ValuePoints: Keeping Up with the PC Market

It's hard to believe that the **IBM Personal Computer Co.** is an offspring of monolithic, sluggish Big Blue when, just six months after introducing the first PS/ValuePoint PCs, the vendor ships 40 new ISA-based models with VESA local-bus video and new high-resolution, multiscan displays. The latest ValuePoints come in three flavors: the SpaceSaver, with three slots and three drive bays; the DeskTop, with five slots and five drive bays; and the Mini-Tower, with eight slots and six drive bays. Processors range from the 25-MHz 386SLC and 25-MHz 486SX to the 66-MHz 486DX2. Hard disks range from 80MB (in the 386SLC) and 120MB (in the 486SX) to 527MB (in the 486DX2 Mini-Tower).

ValuePoint 425SX and 433SX systems can be shipped without floppy or hard disk drives to act as requesters on local area networks. The 4MB systems are preloaded with IBM DOS 5.02 and Microsoft Windows 3.1; 8MB systems come with OS/2 2.001.

- List price: *IBM PS/ValuePoint*, \$1,080 to \$3,579. *IBM Personal Computer Co.*, Rte. 100, Somers, NY 10589; 800-426-2968. Circle 413 on reader service card

IMPROVED

Disk Compression Vendors Answer Microsoft DOS 6.0

Microsoft's DOS 6.0 has disk compression vendors scrambling in different directions: Some are running to their lawyers, others are improving their products, and still others are developing new utilities to enhance MS-DOS 6.0's DoubleSpace. **Stac Electronics'** Stacker 3.1 seamlessly replaces DoubleSpace in the operating system, making Stacker, not DoubleSpace, part of DOS 6.0 and eliminating the need for Stacker commands in your CONFIG.SYS file. It's also compatible with previous versions of DOS as well as Windows; it includes tools for optimization, monitoring, and security; and it supports removable media and disk drives up to 1GB in size.

Vertisoft Systems, the company that licensed technology to Microsoft, has an-

New & Improved

nounced DoubleDisk GOLD 6.0, which offers better performance, Windows 3.1 and DOS 6.0 compatibility, and support for removable media, RAM disks, and unerase utilities. In addition, Vertisoft has unveiled SpaceManager, a utility for DOS 6.0's DoubleSpace that gives you control over compression levels, graphically reports and predicts compression performance, and eliminates the need for mount commands.

AddStor's new DoubleTools provides features similar to the ones in SpaceManager and adds many repair tools. The Adviser analyzes your disk environment and suggests ways to optimize space; the Spanned Media Drive option lets you span and store files across multiple disks; and RescueTools provides a set of utilities for recovering data.

Meanwhile, **Integrated Information Technology** has announced Version 3.0 of its compression program, XtraDrive, which now supports removable media and compresses floppy disks so they can be used in any IBM-compatible PC without a separate copy of XtraDrive.

- List price: *Stacker, Version 3.1*, \$149. *Stac Electronics Inc.*, 5993 Avenida Encinas, Carlsbad, CA 92008; 800-522-7822, 619-431-7474. *DoubleDisk GOLD, Version 6.0*, \$99.95; *SpaceManager*, \$89.95. *Vertisoft Systems Inc.*, Transamerica Pyramid, 600 Montgomery St., San Francisco, CA 94111; 800-466-5875, 415-956-5999. *DoubleTools*, \$99. *AddStor Inc.*, 1040 Marsh Rd., Menlo Park, CA 94025; 800-732-3133, 415-688-0470. *XtraDrive, Version 3.0*, \$98. *Integrated Information Technology Inc.*, 2445 Mission College Blvd., Santa Clara, CA 95054; 800-832-0770, 408-727-1885.

Circle 414 on reader service card

NEW

Swap Video Drivers on the Fly: Cool Tools from Binar Graphics

Binar Graphics, creators of WinSpeed, the first software-only graphics accelerator, has announced two unique Windows utilities. The first product, AnyView, changes Windows video resolutions and pixel depths on the fly so you never need to enter Setup, change drivers, and restart Windows. You can also assign resolutions to Windows applications so that when you're in Word for Windows, for example, the resolution is 640-by-480, but when you switch to Excel, it's 1,024-by-768. AnyView also has a zoom feature for enlarging part of a screen, a virtual desktop feature for making your workspace larger than your display, and a display calibration feature so that your screen output matches your print output.

The second product, Fantastic Recall, acts

BRIEFS

SOFTWARE UPGRADES

Symantec Corp. continues its response to Microsoft DOS 6.0 with the release of The Norton Backup for DOS, Version 2.2 (\$149). The Norton Backup is a superset of DOS 6.0's utility, and is able to read and restore DOS 6.0 backups. Registered users of previous versions of The Norton Backup can upgrade for \$39, while buyers of DOS 6.0 can get The Norton Backup 2.2 for \$69. 800-441-7234, 408-252-3570.

ACT! for Windows from **Contact Software International** is now in Version 1.1 (\$395), with merge features for reconciling data between versions of ACT!, a data link to ACT! for the HP 95LX palmtop, and new filters for importing data from other contact managers and PIMs. Version 1.1 provides DDE links to Windows programs, and has optional auto-rollover of uncompleted activities and a quick-dial phone list. Registered ACT! for Windows users will receive the new version free. 800-365-0606, 214-919-9550.

Version 5.1 of **PC-Kwik Corp.'s** Super PC-Kwik (\$79.95) disk cache software includes cache support for CD-ROM drives using read-ahead technology. Version 3.1 of PC-Kwik Power Pak (\$129.95) is fully compatible with DOS 6.0 and is made up of disk cache, disk optimization, multiple boot configuration, and other utilities. If you're an existing Super PC-Kwik or Power Pak 3.0 user, you can upgrade for \$19.95 and \$39.95, respectively. 800-274-5945, 503-644-5644.

Above Software has upgraded its Windows document manager, Golden Retriever 2.0b (\$99). New "File Save" and "File Open" commands intercept the same commands in other Windows applications and bring up Golden Retriever over the application. A "File Record" command creates an audit trail of document revisions, and an Uninstall option removes the program from Windows and from your hard disk. If you bought Retriever 2.0 or 2.0a after January 1, 1993, the upgrade is free; if you bought prior to January 1, it costs \$25. 800-344-0116, 714-851-2283

like the suspend and resume feature on notebook PCs by saving your Windows session to disk—applications and all—and starting where you left off the next time you boot up. Both AnyView and Fantastic Recall are currently available at introductory prices of \$69.95 and \$49.95, respectively.

- List price: *AnyView*, \$99.95; *Fantastic Recall*, \$79.95. *Binar Graphics Inc.*, 30 Mitchell Blvd., San Rafael, CA 94903-2034; 800-228-0666, 415-491-4182; fax, 415-491-1164.

Circle 416 on reader service card

NEW

Pretty as a Portrait: New Monitor Rotates for Windows

In the arena of pivot displays, Radius is retreating to the Macintosh platform, and **Portrait Display Labs**, which has a strategic relationship with Radius, is filling the void. Its new Portrait/15 Plus monitor rotates so you can view Windows in landscape mode (for spreadsheet programs) or portrait mode (for desktop publishing or word processing programs).

The included software remaps the screen display to match the physical orientation. The 15-inch Portrait/15 makes no performance compromises; it supports 1,024-by-768 resolution at noninterlaced refresh rates above 70 Hz, has a .28-mm dot pitch, and meets MPR II standards for reduced emissions. Drivers that support OS/2 are in the future.

- List price: *Portrait/15 Plus*, \$799. *Portrait Display Labs*, 46712 Fremont Blvd., Fremont, CA 94538; 800-858-7744, 510-249-0444; fax, 510-249-0445.

Circle 415 on reader service card

NEW

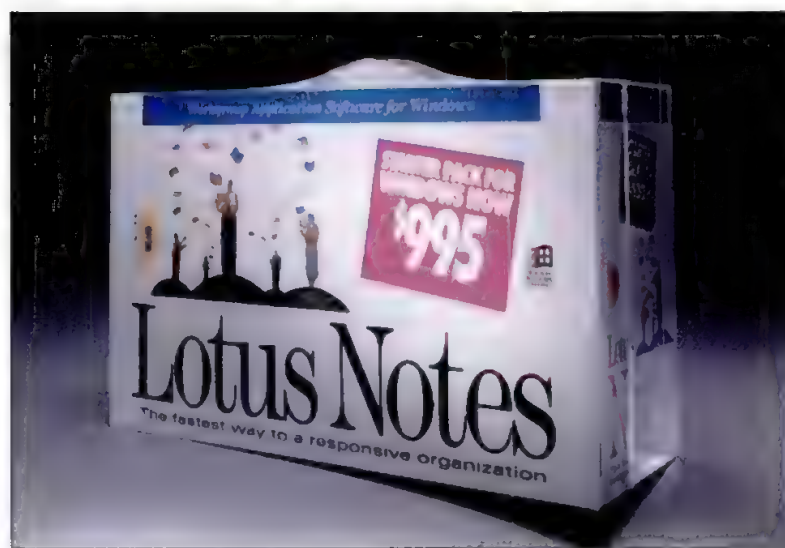
Swfte Brings Jan Brady, The Fonz to TrueType

With products like **Swfte International's** Typecase III TrueType fonts for Windows, desktop publishing and word processing will never be dull. Among the over 100 typefaces is Jan Brady, the font that daily introduced "The Brady Bunch" to millions of TV viewers in the 1970s, and Happy Days, the neon sign-shaped



The Portrait/15 Plus pivots to portrait mode.

Now there's only one thing standing between you and the power of Lotus Notes. Shrinkwrap.



Introducing the Lotus Notes Release 3 Starter Pack for just \$995.

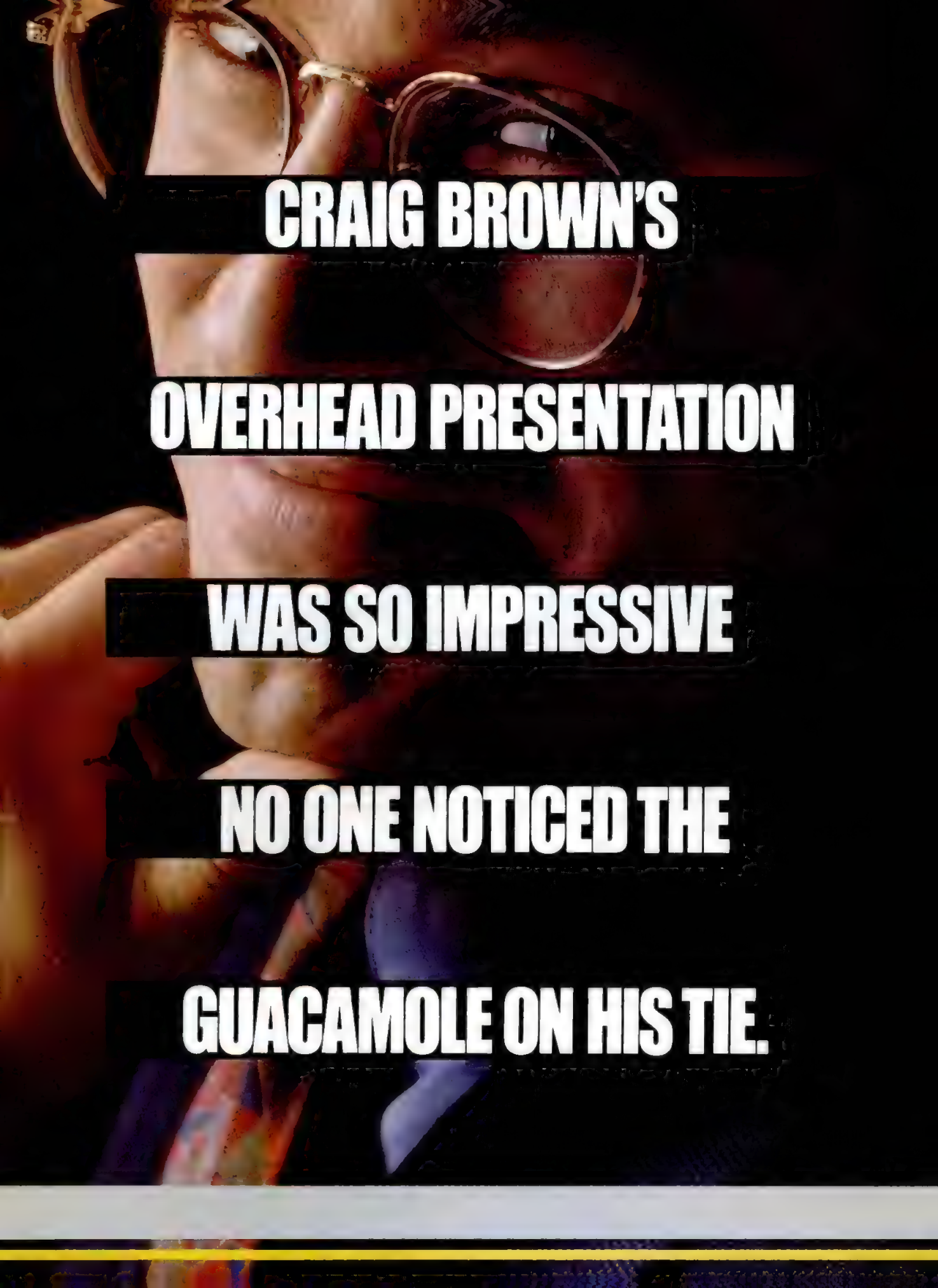
Lotus Notes® is hailed as a dramatic breakthrough in competitiveness. It improves essential business processes by allowing people to access, track, share and organize information in ways never before possible.

And with Release 3, Lotus Notes is available in a Windows® server version. A development which prompted us to offer the new Starter Pack for Windows® at just \$995. It comes complete with one Lotus Notes Server for Windows® and two Notes Clients for Windows®. Plus there are 25 ready-to-go applications that allow you to improve business processes like account management, customer service and product

development. All of which will help you stay competitive.

To realize the full potential of Notes all you need is Windows®, a LAN, and about \$1000. So stop by your nearest Lotus Authorized Reseller. Or call us at **1-800-828-7086, ext. 8889**, for more information. But do it soon, because this offer is available to everyone. Including your competition.

Lotus Notes



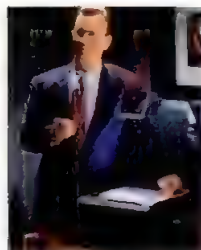
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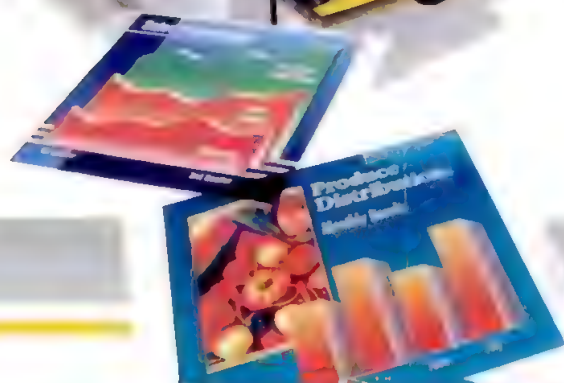
The KODAK COLOREASE PS Printer. Continuous-tone transparencies and prints. Superb resolution. Plus *UltraColor* Software from Kodak that gives you great color the first time, and every time. True Adobe PostScript® Level 2. Fully compatible with your MACINTOSH Computer or WINDOWS Software. With simultaneous printing and processing to maximize your productivity. No other printer can do so much, so fast.

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New & Improved

DEEP FREEZE: AaBbCcDdEeFfGgHh
Happy Days: AaBbCcDdEeFfGgHh
Jan Brady: AaBbCcDdEeFfGgHh
SHAKAZULU: AaBbCcDdEeFfGgHh

Swfte's new fonts include some flashbacks.

font that calls to mind soda shops and The Fonz. Typecase III also comes with a font management utility that lets you organize your fonts into groups, as well as remove and add fonts in seconds. With it you can deactivate fonts and compress them to conserve disk space.

- List price: *Typecase III*, \$49.95. Swfte International Ltd., Stone Mill Office Park, 724 Yorklyn Rd., Hockessin, DE 19707-8701; 800-237-9383, 302-234-1740; fax, 302-234-1760. Circle 417 on reader service card

NEW

LaserMaster Ships Thermal-Wax Printer at Hot Price

If you're looking for an inexpensive color printer for layouts or presentation materials, **LaserMaster Corp.** may have what you need in its new CrayonFX Color Printer. The CrayonFX is a thermal wax transfer printer with a low \$1,495 price tag (other thermal wax transfer printers go for twice that). It uses three-color or four-color ribbons, yielding 115 or 80 prints per roll, respectively, and provides a resolution of 203 dots per inch. It supports letter and A4 paper, prints at a rate of 2.5 minutes per page, and includes both LocalTalk and parallel interfaces. The CrayonFX has ties to Microsoft Windows, since you'll need Windows 3.1 to use the 50 bundled TrueType fonts, and the printer is networkable using Windows for Workgroups.

- List price: *LaserMaster CrayonFX Color Printer*, \$1,495. *LaserMaster Corp.*, 6900 Shady Oak Rd., Eden Prairie, MN 55344; 800-477-7714, 612-944-9330; fax, 612-944-0522. Circle 418 on reader service card

IMPROVED

Microsoft Access Upgrade Well Connected

Microsoft Corp.'s Windows-based relational database management system, Microsoft Access 1.1, now lets you share information more easily across a wider variety of data sources. Version 1.1 can read and write Oracle

BRIEFS

SOFTWARE UPGRADES

Abacus Systems' accounting software, Abacus II, Version 2.0 (\$995 for a single user), is aimed at those users who need to upgrade from low-end accounting packages but who aren't interested in high-end, high-priced, modular packages. For a limited time, an integrated, unlimited-user, network version with job estimating and costing, inventory, order entry, point of sale, payroll, taxation, and more is available for \$99.95. 800-992-0616, 701-838-4686.

PCs

Texas Instruments has announced a new model of the TI TravelMate 4000 WinDX2/50 notebook PC (Editors' Choice winner, March 30, 1993), which was previously only available with 8MB of RAM and a 200MB hard disk. The new model lists for \$3,099 and has 4MB of RAM and a 120MB hard disk. In addition, TI announced price cuts from \$100 to \$700 across its TravelMate line. 800-527-3500.

Dell Computer Corp. has increased its ready-to-run multimedia offerings to 13 and introduced a line of five Business Starter PC bundles for out-of-the-box performance. New ChildrenStation, FamilyStation, InformationStation, and StudentStation multimedia PCs (starting at \$1,899) come with local-bus video and a socket for a future Intel Pentium processor, in addition to a CD-ROM drive, sound card, and external speakers.

The **Business Starter PCs** (starting at \$1,199) come in desktop and notebook configurations with 4MB of RAM and 80MB or 120MB hard disks and an assortment of software, including After Dark for Windows, Lotus Organizer, Microsoft Entertainment Pack, Microsoft Works for Windows, and Quicken 2.0 for Windows. 800-289-3355.

Epson America is offering a new line of entry-level, Intel 486-based PCs called the Equity 4 family (\$1,229 to \$1,949). 120MB and 240MB hard disks are available and the processors are upgradable with Intel OverDrive processors by way of a ZIF (Zero Insertion Force) socket. The basic video subsystem has 512K of video memory. 800-289-3776.

and Sybase SQL Server data through Open Database Connectivity (ODBC), and connect to Microsoft FoxPro 2.0 and 2.5 data and indexes. It's now easier to import fixed-width text, including variable lengths, and to import Excel database named ranges. There's also a new export option for moving data into Microsoft Word for Windows' mail-merge format, and the maximum database file size has increased from 128MB to 1GB.

Microsoft has also streamlined the process by which Wizards, third-party add-ins that enhance productivity, are added to Access. Upgrades cost \$14.95 through resellers, and \$19.95 direct from Microsoft.

- List price: *Microsoft Access, Version 1.1*, \$495. *Microsoft Corp.*, One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080. Circle 420 on reader service card

NEW

Back Up Colorado Memory Drives with New Utility

Colorado Memory Systems is shipping Colorado Backup for Windows, an add-on to the popular Jumbo 120 and Jumbo 250 drives that features drag-and-drop operation. An intuitive macro recorder lets you schedule unattended backups, and the Stacker data-compression algorithm compresses the files from your drive. It's QIC-40 and QIC-80 compatible, supports popular peer-to-peer networks, and backs up drives compressed with DOS 6.0's DoubleSpace. A new Move feature lets you



Drag-and-drop backup: Colorado Memory Systems' new Backup for Windows.

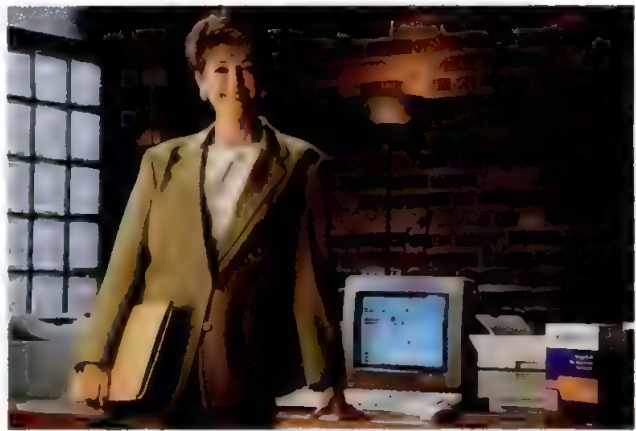
groom disks and free space by moving seldom-used files to an archival tape. Versions that support Colorado's PowerTape and Trakker families are due later in the year.

- List price: *Colorado Backup for Windows*, \$59. *Colorado Memory Systems Inc.*, 800 S. Taft Ave., Loveland, CO 80537; 800-451-0897, 303-669-8000; fax, 303-667-0997. Circle 419 on reader service card

Once I started managing my information with PageKeeper, I realized I could get back to being a manager.

My staff hardly knew who I was anymore. I was so buried in data I never thought I'd see any of them again. Then our MIS guy suggested PAGEKEEPER.™ The results were fantastic. The first thing I did was let PAGEKEEPER index the files on my hard drive – so I rediscovered all kinds of stuff I thought I'd lost.

Then I started scanning in the piles of paper on my desk. PAGEKEEPER's built-in OCR automatically reads any document and stores it *intelligently*. But the scanned image is still there – charts, graphs, scribbles, even coffee stains. Giving me



access to all my information. But for me, retrieval is where this product really shines. I've never been able to find information so fast – or so easily. I simply type in a few words I think the document contains and PAGEKEEPER does the rest. Caere's new Weighted Relevance Retrieval™ technology means the documents I'm most interested in are right at the top of the list. And when I've found what I want, PAGEKEEPER's built-in e-mail lets me easily share information with my whole team.



That's my PAGEKEEPER story. The one that let me get back to my job. To get your copy of PAGEKEEPER, see your local Caere dealer or call Caere for more information: **1-800-535-SCAN.**



For Your Information.

NEW

FEB Software Hatches Plot to Convert Graphics to Data

Famous Engineer Brand Software's popular desktop digitizing software for the Macintosh is now available for the PC. **digiMatic** for Windows converts graphical information to editable numerical data. The data can be saved as tab-delimited text and imported into databases, spreadsheets, or any other program. Now you can extract information from charts and graphs that appear in sources such as technical journals with precision up to four decimal places. The software supports scanned images and digitizing tablets and has tools for modifying scanned graphics before digitizing. You can capture up to 4,000 data points in a single session. Students and university personnel can buy **digiMatic** for Windows for \$149.

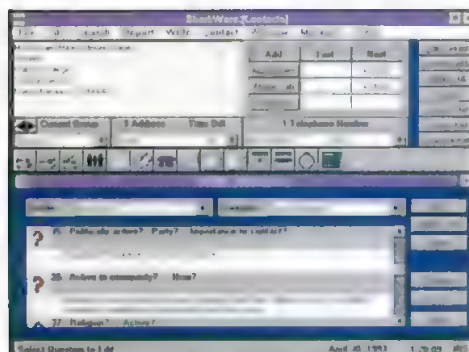
• List price: *digiMatic for Windows, Version 1.0*, \$249. **Famous Engineer Brand Software**, 4855 Finlay St., Richmond, VA 23231; 804-222-2215; fax, 804-226-1934.

Circle 421 on reader service card

NEW

Just When You Thought It Was Safe to Buy a Windows PIM...

Harvey Mackay, best-selling author of such business-management books as *Swim With The Sharks Without Being Eaten Alive*, has given his endorsement to a personal information manager (PIM) from **CogniTech Corp.** called **Sharkware**. The Windows-based program has an easy-to-use interface complete with drag-and-drop, and all the standard tools, including a contact manager, calendar, to-do list, and automatic call log, plus DDE links to **Ami Pro** and **Microsoft Word** for Windows. You can also import and export ASCII files. What it lacks in advanced features (such as e-mail support) it makes up for in on-line advice: In addition to a



Sharkware features help from Harvey Mackay.

BRIEFS

PCs

Lightning Computers is shipping the **ThunderBox II** (\$5,895), a high-end, 66-MHz 486DX2-based EISA system with VESA local-bus video that uses **Wetek's** P9000 chip, a **Pentium** multi-processor upgrade path, 16MB of RAM, and a 1.2GB SCSI-2 hard disk with a 4MB caching controller. 800-347-4486, 415-543-3111.

MODEMS

Best Data Products is bundling its internal 2,400-bps modem with **The Sierra Network's** (TSN) multiplayer game software to create the **Game Modem** \$49.95. The included TSN Membership Kit gives you three free hours of evening/weekend access to over 20 on-line games and comes with a \$30 credit toward TSN membership and usage. A basic TSN membership costs \$12.95 a month. 800-632-2378, 818-773-9600

Computer Peripherals is shipping the \$449 **Viva 14.4/FAXp**, a 14,400-bps pocket data/fax modem with V.42bis and MNP 5 data compression, plus V.42 and MNP 2 through MNP 4 error correction. The 1.2-by-2.5-by-4.5-inch (HWD), Class 1-, 2-, and Group 3 fax-compatible modem connects via a 9-pin serial cable and is powered by a 9 volt battery or a wall-mount transformer. 800-854-7600, 805-499-5751.

Hayes Microcomputer Products has introduced a new low-cost line of modems to complement its **Ultra** and **Optima** lines. The ten new **Accura** modems (\$79 to \$339), designed for small business and home office use, range from a 2,400-bps internal data modem up to a 14,400-bps external data/fax modems. 404-840-9200

In related modem news, **Hayes** is shipping **Smartcom** for Windows, Version 1.0 (\$149), a full-featured asynchronous communications software package designed for advanced communications environments. The program's **Smart Buttons** let you keep common commands and frequently used scripts available at the click of a button. **Smartcom** for Windows is available now for an introductory price of \$49. 404-840-9200

variety of preprogrammed Mackay profiles, such as the 66 things you should know about your contacts (from their hobbies to their religion), **Sharkware** has on-line quotes from **Harvey Mackay** on achieving greater success. You can program **Sharkware** so that every time you begin your day's work, a **Quote Of The Day** pops up as your first screen.

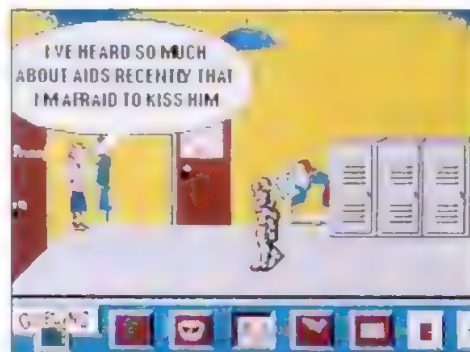
• List price: *Sharkware, Version 1.0*, \$129.95. **CogniTech Corp.**, P.O. Box 500129, Atlanta, GA 31150; 404-518-4577; fax, 404-518-4588.

Circle 422 on reader service card

NEW & IMPORTANT

Raya Systems Strikes Serious Note With AIDS Education Game

It's about time a company made an easily accessible software program to educate today's young people about the myths and realities of AIDS. **Raya Systems** is shipping **The AIDS Avenger!**, an interactive game in which you're the superhero, and you must travel through various scenes fighting fear and ignorance by disseminating information. When you overhear a character making false assumptions about AIDS and HIV, you are prompted to provide the correct information from a choice of statements. If



The AIDS Avenger! fights fear and ignorance by educating the game's characters.

you choose correctly, you're awarded points and you exorcise a goblin of ignorance. There are four levels to the game, which address more mature topics the higher you go. For parents who don't want their younger children exposed to the frank issues that are dealt with in higher levels, the game has a lock-out feature that can be controlled with a password.

Best of all, proceeds from the sale of **The AIDS Avenger!** go to **The American Foundation for AIDS Research**.

• List price: *The AIDS Avenger!*, \$39.99. **Raya Systems Inc.**, 2570 W. El Camino Real, #309, Mountain View, CA 94040; 800-874-1993, 415-949-3933; fax, 415-949-3935.

Circle 423 on reader service card

The superior LAN system.



OS/2 was designed
to make the most of your network.

Now all that client-server computing was supposed to be, can be. Because OS/2® was designed from the kernel up to support client-server computing, you can find it easier than ever to quickly and efficiently deliver data to users anywhere in the PC enterprise.

As a client, OS/2's rich set of networking capabilities provides the user with customized network resources for

maximum productivity. As a server, OS/2 provides a protected-mode, multitasking environment and multiple threads of operation, so large numbers of workstations on the network can access the server. Along with LAN Server 3.0, IBM DATABASE 2 OS/2® (DB2/2®), Communications Manager/2 and NetWare® from IBM, OS/2 can deliver the functionality, flexibility and high performance to maximize all your network resources.

1. OS/2 makes the network adapt to you rather than the other way around.

Finally, we have transparent networking. OS/2 gives you an easy way to customize your networking environment via the Workplace Shell.[™] Because the Workplace Shell is object oriented, it graphically represents a network operating system such as IBM LAN Server or NetWare.[®] So you are treated, for example, to a graphical display of all the available services on the network through OS/2's resident Desktop. A remote device will appear to be local.

2. Multithreading adds value to accessing servers.

Because OS/2 employs multiple threads, OS/2 communications programs can efficiently access several servers at the same time. For example, a user can download large files via high-speed modem in the background, while working within an

E-Mail program in the foreground.

OS/2 simplifies communications by providing the richest set of communications APIs of any system, including TCP/IP, X.25, asynchronous and other access methods. OS/2 also provides a cohesive communications environment by supporting common networking topologies, including Ethernet and Token-Ring.

3. Tip: Going places in the Workplace Shell.

You can use the OS/2 Workplace Shell to include objects and resources in your local machine Desktop configuration. With the Workplace Shell Network Object, you navigate to remote objects by pointing and clicking with your mouse. The Network Object is a folder in the Workplace Shell; the objects within the folder are server objects. After selecting a server, use standard Workplace Shell procedures to include remote objects in your Desktop configuration. For example, by holding down the CTRL key and the right mouse button on a remote object, you

drag a shadow of that object onto your Desktop. Once a remote object is in your Desktop configuration, you work with it just as easily as with local objects.

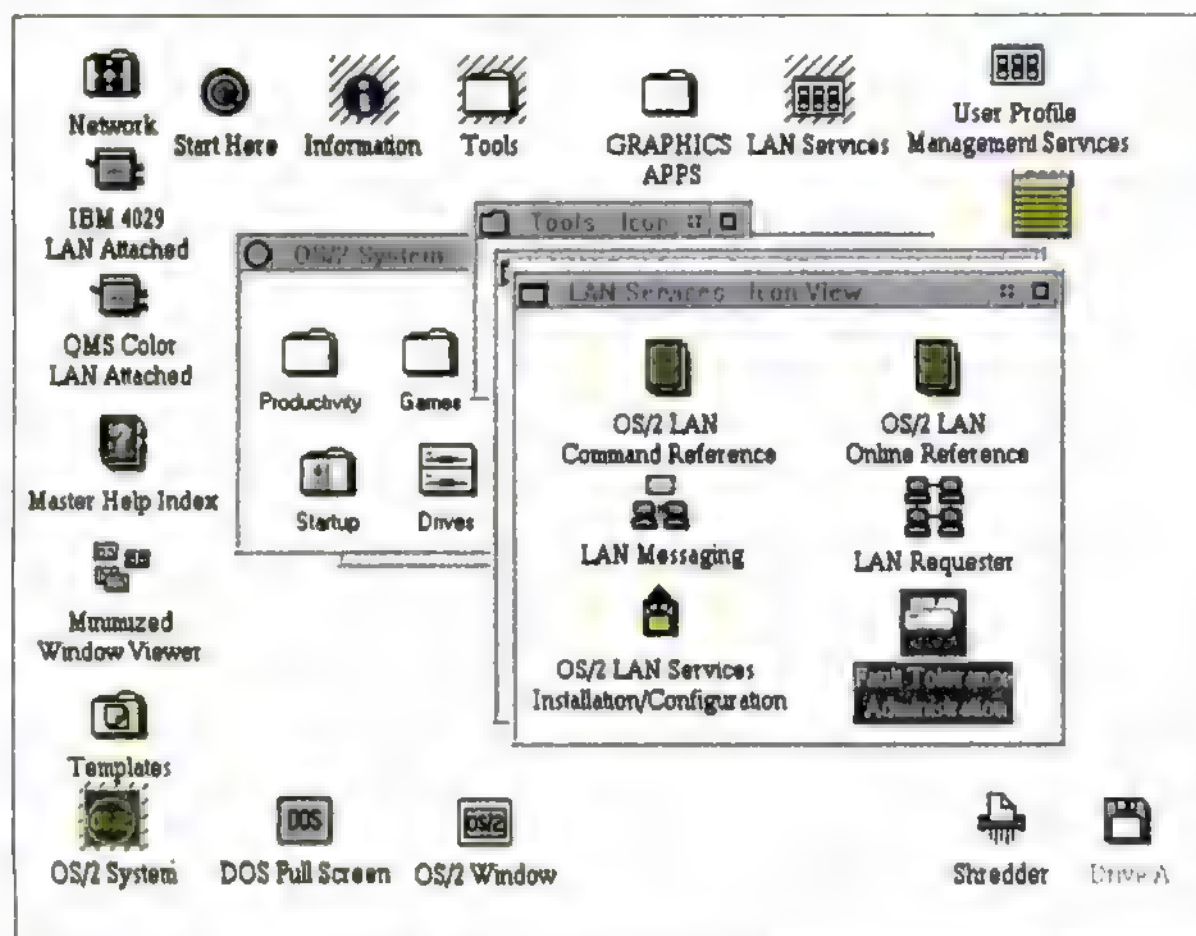
4. Communications Manager/2 helps to make the connection.

Getting information from one PC to another computer in an office—or around the world—can be a daunting task. Communications Manager/2 gives you terrific connectivity to access this data on compatible mainframes, minicomputers and personal computers.

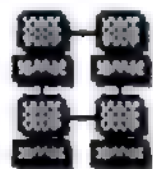
Communications Manager/2 links you to a variety of IBM and non-IBM applications running on multiple servers. It does this by emulating IBM 3270, IBM 5250 and ASCII terminals. Since OS/2 is a multitasking operating system, you can simultaneously transfer files to and from several different servers. The peer-to-peer communications capabilities let different OS/2 workstations on a network share resources and tasks. Support of the Network Device Interface Specification allows you to pick the best network interface card for your hardware from a variety of manufacturers. It also allows you to connect to multiple servers off a single card.

5. IBM DATABASE 2 OS/2 makes information count.

DB2/2 adds standalone database functionality to your OS/2 workstation. It is a relational database with SQL (Structured Query Language) compatibility, which allows it to speak the language of IBM host data management systems like SQL/Data Systems[™] and DB2[®] and databases that support Distributed Relational



Database Architecture™ (DRDA). Issue SQL statements, commands and utilities directly from OS/2 command line. Or use a friendly graphical interface for querying, reporting, data entry and editing, and creating tables. Even



DOS and Windows™ applications can get information from DB2/2 databases,

LAN Requester with no need to learn SQL syntax to access, update and administer data. If you want to put network database information in a central location, look to the optional. The client-server version acts as an information host for the DB2/2 clients on your network. It provides OS/2, DOS and Windows client applications access to remote OS/2 database servers, making it seem as though the data hosts were managing the information right at your desk.

6. LAN Server 3.0 makes a difference across the LAN.

Unlike a dedicated network operating system, LAN Server 3.0 is built on top of OS/2. So you get the benefits of pre-emptive multitasking, enhanced OS/2 Crash Protection™ and the Workplace Shell GUI. Advanced and Entry versions both support the latest versions of OS/2, DOS and Windows on Token-Ring, Ethernet and IBM PC Network. There's support for Peer Services, optional support for Macintosh® computers and TCP/IP, and you can connect more than 1,000 users on a single LAN.

LAN Server's Advanced version offers a High Performance File System (HPFS) that decreases access time to the server's hard disk, improves security and offers fault tolerant features like disk duplexing and disk mirroring.

And LAN Server 3.0 goes beyond simple resource sharing with management enhancements that are systemwide. With sophisticated local and remote system management tools for installation, diagnostics and user security, your LAN will work more effectively with less downtime. Plus LAN Server 3.0 provides an IBM migration path to OSF's emerging DCE standards.

7. OS/2 unleashes the power of NetWare.
With OS/2 running a client workstation on a NetWare® LAN, you can take full advantage of OS/2's pre-emptive multitasking and multithreading. Several applications can be run at the same time using a variety of network resources—from a local server to a host computer on a public network.

NetWare 4.0 gives you added features and functionality, such as distributed directory services, security, auditing and enhanced network management. And with OS/2 and NetWare for OS/2, you get a full-function, high-performance single hardware platform for OS/2 applications.

8. OS/2 brings systems management into the forefront.
With the CID Process (Configuration, Installation, Distribution), OS/2 makes it simple to install and maintain the software configurations on OS/2-based client workstations. And with products from the recently announced LAN NetView® family, you get industry-leading solutions for LAN systems management.

This means OS/2 can be installed, tailored and maintained on a client workstation without any additional diskettes. The LAN administrator may

centrally manage the installation of client machines and even upgrade end users' software from the code server. This saves the time and expense of manually performing these operations at each client workstation. And LAN NetView lets you monitor the usage of precious LAN resources, too. Monitoring, problem analysis and record-keeping can be much easier for LAN administrators.



LAN NetView



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a list of documents" followed by 1 for the "Personal Systems" section. We'll send you the fax right away.

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In Canada, call 1 800 465-7999.



Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Multimedia Without the Hype

BY DAVID ANGELL AND
BRENT HESLOP

Multimedia is a catchall phrase for the convergence of media technologies with computing. It's also the wild West of desktop computing, where untamed standards, constantly changing products, and lots of hype abound. One thing's for sure: Harnessing multimedia requires know-how. Here are three new books that help.

Multimedia Madness chronicles the multimedia adventures of author Ron Wodaski. Enthusiastic yet pragmatic, his evangelistic writing style reflects his own multimedia madness. The result is good advice on sound, graphics, animation, video, and authoring.

Wodaski's educated opinions come through loud and clear; products that pass muster are branded with an Author's Choice. He tours multimedia programs and covers sound boards, CD-ROM drives, video cards, MIDI hardware, and upgrade kits. The reviews are presented as a shopper's guide.

The accompanying CD includes a special edition of *Nautilus*, a slick multimedia magazine, and demos of 3D Studio, HSC Interactive, Microsoft Bookshelf, Multimedia Beethoven, and Multimedia Toolbook. A floppy disk includes Graphics Workshop, Wave Editor, Microsoft Media

Player, WinJammer, and a speaker driver for Windows.

In *Discover Windows 3.1 Multimedia*, author Roger Jennings offers surefooted guidance on setting up a multimedia PC, mastering Windows' sound capabilities, and dabbling in video. You'll find instructions on installing a CD-ROM drive, sound board, and video card, and on setting up I/O addresses, interrupts, drivers, and DMA settings.

Since sound is one of the most developed multimedia features in Windows, over half the book explores the vast array of Windows sound applications. Jennings has extensive MIDI experience, and it shows in his encyclopedic coverage.

Coverage of the video realm is more basic, reflecting the primitive state of PC video production. Although the information on authoring tools is weak, Jennings provides a meaty introduction to the Media Control Interface (MCI), a programming language that controls multimedia devices in Windows.

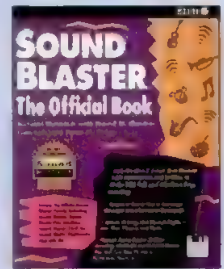
A glossary of terms and useful appendixes cover Microsoft's CD-ROM Extensions (MSCDEX) driver, a vendor list, and instructions for downloading driver files. The accompanying disk of common shareware programs is somewhat of a letdown.

In *The Desktop Multimedia Bible*, Jeff Burger takes a differ-

■ Understanding Sound

The PC's sound capability has come a long way, thanks to sound cards such as Creative Labs' Sound Blaster. It can open a new dimension in music, multimedia presentations, games, and educational software. If your card is underutilized or you might buy one, read *Sound Blaster: The Official Book* (Osborne/McGraw-Hill, \$29.95).

Rich Heimlich and his fellow authors make technical topics such as Musical Instrument Digital Interface (MIDI) and FM synthesis understandable, offer clear instructions on installing the card and making music with Sequencer Pro Plus, explore the new Sound Blaster 16 ASP, include a tech support Q&A, and cover programming topics. You'll also find reviews of multimedia software and PC speakers. The accompanying disk includes a sound editor and sound files.—Charles Taft



ent approach by focusing on theories and techniques that will enable you to work with several multimedia technologies. Right from the start, he hits you with communications theory, concepts of electricity, and multimedia equipment.

Past the first six chapters, the book gets into practical areas of graphics, sound, video, and emerging interactive tools. Burger explains the theory of each medium and its tools, then explores expert production techniques. In the chapter on

for a large audience.

In summary: *Multimedia Madness* is a good multimedia buyer's guide, *Discover Windows 3.1 Multimedia* is a real find for setting up a multimedia PC and learning about sound, and *The Desktop Multimedia Bible* offers a technical grounding in multimedia production. □

• **Multimedia Madness**, by Ron Wodaski, \$44.95. Sams Publishing; 800-428-5331. ISBN: 0-672-30249-7.

Circle 460 on reader service card

• **Discover Windows 3.1 Multimedia**, by Roger Jennings, \$39.95. Que Corp.; 800-428-5331. ISBN: 1-56529-060-7.

Circle 461 on reader service card

• **The Desktop Multimedia Bible**, by Jeff Burger, \$32.95. Addison-Wesley Publishing Co.; 800-447-2226. ISBN: 0-201-58112-4.

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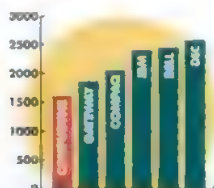
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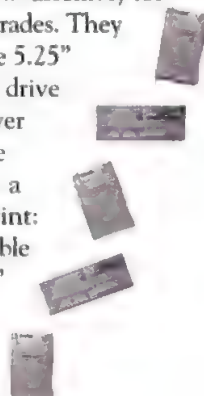
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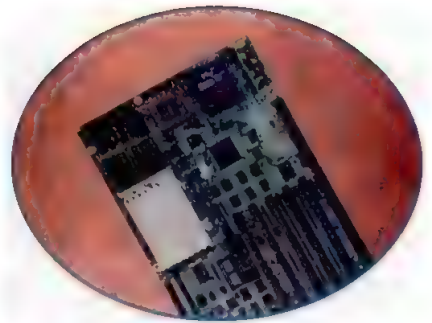
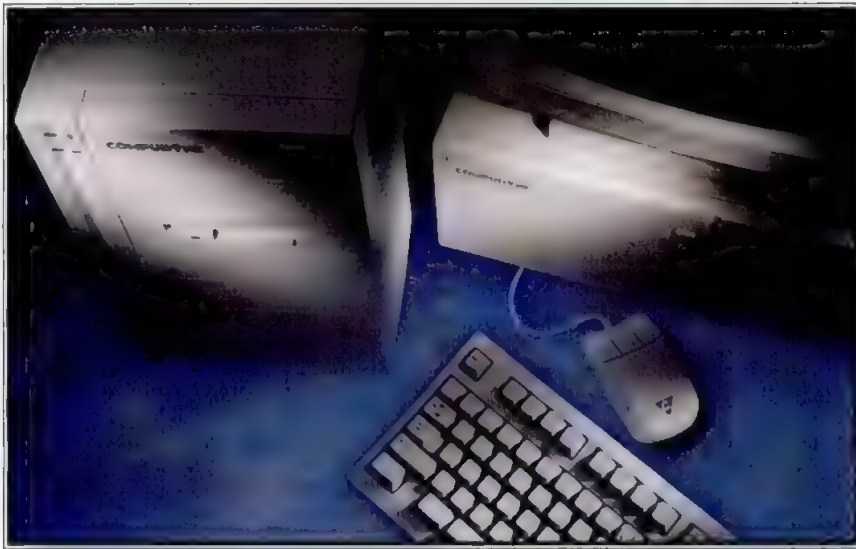
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REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

Top Off CodeView Debugging with CV/ICEing

BY RICK KNOBLAUGH

If you use Microsoft's CodeView 4.x, you'll love CV/ICEing from The Periscope Company. CV/ICEing supplements the CodeView command set, giving you the ability to set breakpoints on I/O accesses, interrupts, ranges of memory accesses (via paging), and 80386/486 debug registers (hardware registers that enable real-time execution and data access breakpoints).

CV/ICEing's integration into the CodeView environment is seamless: When CV/ICEing is present, CodeView accepts 12 new commands as if they were its own. CV/ICEing distinguishes its commands from CodeView's commands by a special naming convention: All CV/ICEing commands begin with the letter Z. For example, ZP is used for setting a breakpoint on an I/O port access. CV/ICEing commands accept parameters using the current CodeView radix and program symbols.

After you set breakpoints and issue the CodeView Go command, CodeView will gain control when a breakpoint occurs just as it does with normal CodeView breakpoints.

HOW CV/ICEING WORKS

Programs that execute in protected mode do so at various privilege levels. The most privileged code (typically an operating system kernel or system-level support tool) can restrict less-privileged programs' access to I/O ports or their use of

interrupts. In this way, debuggers using protected-mode features can gain control when these events occur. These debuggers can also take advantage of the 80386/486's hardware debug registers and memory-paging capabilities to generate breakpoints on code execution or memory accesses.

CV/ICEing uses an innovative approach for providing protected-mode debugging capabilities. Unlike some other debuggers that contain built-in support for virtualizing the DOS environment, CV/ICEing makes use of 80386/486 protected-mode capabilities provided by Qualitas's 386MAX (which Microsoft ships with C/C++ 7.0). CV/ICEing is loaded by 386MAX and operates at the most privileged level (Ring 0) with the 386MAX DPMI (DOS protected-mode interface) host. Because of this, much of the extremely complex protected-mode code that executes DOS as a V86 (virtual 8086) task doesn't need to be part of the debugger.

BREAKPOINT POWER

CV/ICEing increases CodeView's debugging power and efficiency. Although CodeView has the ability to set breakpoints on ranges of memory accesses, execution is sluggish: It evaluates the breakpoint condition as each instruction executes. CV/ICEing provides this feature without impacting performance.

CV/ICEing has two varieties of its breakpoint-on-memory-access feature: ZR and ZM. ZR

uses 80386/486 debug registers to generate breakpoints on byte, word, or double-word memory accesses. The ZM command generates breakpoints on ranges of memory accesses with lengths between 1 and 65,535 bytes. These commands can also be used for setting breakpoints on code execution, including ROM code.

If you write programs that interface with hardware, you'll especially appreciate CV/ICEing's breakpoint on I/O port access command (ZP). With this one, you can set breakpoints on ranges of I/O accesses, qualifying

breakpoints on input, output, input/output, and other conditions. The /T command option, available on all commands, allows you to specify that data values in registers (or memory) meet your conditions before a breakpoint is generated. Bit masks also can be used when providing a test on a value. For example, ZP 20 0 /T: AL MASK xx1x xxxx causes a breakpoint anytime the AL register has bit 5 on when its contents are written to port 20.

The breakpoint on interrupt command (ZI) provides a powerful means of gaining control when interrupts occur. By using /T, you can specify that the AH register contains a certain function code. For example, ZI 21 /T: AH EQ 44 sets a breakpoint for INT 21 function 44 calls.

CV/ICEing offers flexibility in setting up the conditions for which breakpoints are to be generated. In addition to the /T option, /P (the pass count option) allows you to trigger breakpoints only after a certain number of occurrences. The /R

option resets the breakpoint hit count. With /C, you can have one or more CodeView or CV/ICEing commands (including those which enable/disable other breakpoints) be automatically executed when breakpoints are encountered. The ZX command allows you to further qualify breakpoints by specifying that breakpoint conditions be met only when the

code is within (or not within) a certain range. For example, ZX f000:0 f000:ffff excludes BIOS code from generating CV/ICEing breakpoints.

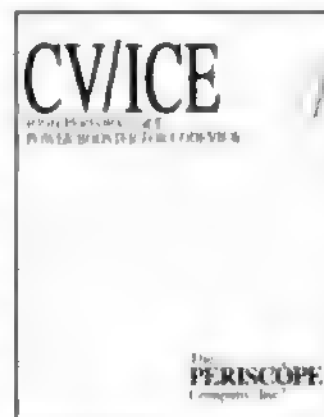
Having access to CV/ICEing's system-level breakpoint capabilities is beneficial in more ways than one. By combining all of these breakpoints, you not only add to your debugging arsenal, but also gain a great set of tools for learning about your PC. For instance, by setting breakpoints on interrupt 5 (the print screen interrupt), interrupt 17h (the printer software interrupt), and an I/O range of 378h to 37Fh (printer I/O space), you could explore some of the system activity that occurs when you print a screen.

If you use CodeView, CV/ICEing is a worthy addition to your debugging toolkit. □

• CV/ICEing, Version 1.0

List Price: \$129 (introductory price is \$99). Requires: 80386 or later CPU; DOS 3.0 or later; Microsoft's CodeView, Version 4.0x (included with C/C++ 7.0) or CodeView, Version 4.1 (included with Visual C++), and 386MAX 6.x. The Periscope Company Inc., 1197 Peachtree St., Atlanta, GA 30361, 404-875-8080.

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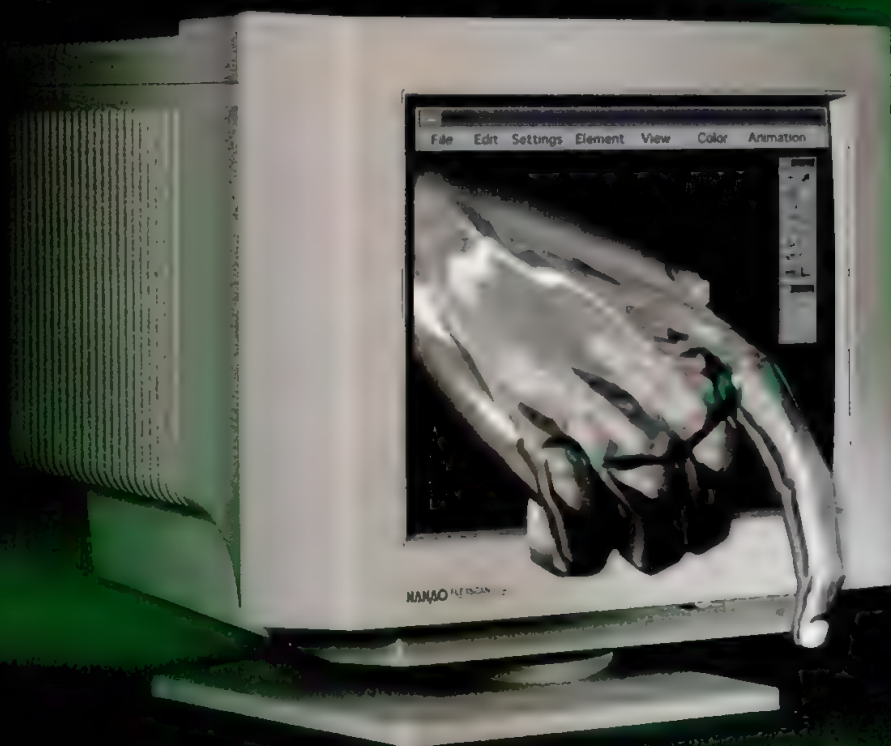
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Michael J. Miller

Testing in the Real World

Video performance has become one of the most controversial subjects in PC hardware today. Vendors of graphics adapters and chips routinely accuse one another of “cheating” on benchmark tests. At *PC Magazine*, we’ve found ourselves at

the center of the controversy.

We’ve developed a set of Windows graphics performance tests, called Winbench, that are widely used to compare boards. Our Winbench tests have become so important in the minds of many manufacturers that they design their products specifically to get the highest possible Graphics Winmark score. Unfortunately, they often lose sight of the fact that better scores are important only if they are reflected in real applications.

To understand how this works, we must look at the way Windows handles graphics. Windows applications don’t write directly to the display. Instead, they use one of the internal Windows graphics functions to display information on screen. *Graphics accelerator chips*—widely used in video boards today—are designed to execute some of these functions on the video board itself, rather than relying on the system’s CPU and memory. These chips typically accelerate simple procedures such as line drawing, area fills, and BitBlt operations (used in moving images from one part of the screen to another, such as dragging an icon or an object in a drawing program). A good accelerator-based video card can perform 15 times as fast as the older *frame-buffer* boards.

Applications use these functions via a display driver that is integrally linked with the video board. Because the driver is such an important part of video performance, many vendors introduce very frequent updates of their drivers. Some updates fix known problems, some add features, and some boost performance. Sometimes these drivers are unstable, and sometimes they have features that improve performance only in benchmark tests.

Perhaps no one has introduced new drivers as quickly as ATI Technolo-

gies. The company says that applications, because they are continually changing, are moving targets, and that customers want new features and fixes as quickly as possible. That may be so, but I don’t want to think about what would happen if every software package got a new version each month!

ATI’s recent test performance has been controversial, because its drivers use a technique called *device bitmap caching*. Manipulating an image typically involves moving bits in the system’s main memory and then displaying them on screen. Bitmap caching works by letting the driver store part of the screen image in video memory so that it can be reused, eliminating the need to go back to main memory, thus making the operation much faster. This *screen-to-screen* operation is much faster than the more common *memory-to-screen* operation, because the driver doesn’t need to move data across the system bus from the system’s main memory into video memory. Bitmap caching can speed up the appearance of dragging icons and elements, as well as the performance of paint and similar programs, but it doesn’t really improve performance in most other Windows apps. However, it dramatically increases the

Graphics Winmark score, because a large part of the Winbench test manipulates an image that is already on the screen.

When we last looked at video accelerators (“Waking Up Windows,” April 13, 1993), a number of video board vendors complained about bitmap caching. They say that because boards with bitmap caching don’t move memory across the system bus, they unfairly go around the test and get artificially inflated scores. ATI notes that bitmap caching does improve some applications and is documented in



Competition is so fierce that video board makers accuse each other of cheating on our tests.

Michael J. Miller

Microsoft's Windows 3.1 driver development kit. Because bitmap caching has an impact in some applications, we don't disqualify drivers that use it.

Number Nine Corp. disagreed so strongly about our allowing bitmap caching that the company prepared its own driver to cache single-text strings. This technique improves performance only in cases where the same text is repeated a number of times—only in tests. The company agrees that single-text string caching has no impact on real applications and says it has removed this feature from its current drivers.

We had a different problem with the driver used by the Hercules Graphite card. Written by Integrated Information Technology, which makes the AGX-014 graphics chip on the board, the driver included a hard-coded text string used in Winbench. Hercules says it was not aware of the text string. Since March, IIT and Hercules have shipped drivers without the text string.

One thing that all of these issues make

clear is that no single Graphics Winmark necessarily reflects the performance you'll get in real applications.

So you ask, why don't we simply test with applications? That's a good question—one I've asked myself, as I personally believe strongly in applications-based tests.

The answer is just as simple. Applications-based tests can only tell you what the bottom-line is; they can't tell you what lies behind the performance score. If you use a different part of the application, or a slightly different application (say, a new version), your score may change markedly for no apparent reason.

That's why we originally created Winbench, which tests the performance of each of the 134 separate graphics functions supported by Windows. Because the original test gave 134 separate results, it was hard to compare two boards or two machines. So with Winbench 2.5, we introduced the Graphics Winmark, a single number that was the weighted average of the most common commands. Later, we introduced version 3.1, in which the weighting was refined to better reflect our profiles of the ways in which people actually use apps.

Because it provides all the details, Win-

bench lets us look at performance in depth—something that would not be possible were we only using applications. But in our last video story, we did make a mistake: Although we tested the boards with several real applications, we published only the Graphics Winmark results. We should have published both sets of results.

That's exactly what we'll do in the next issue, when we take another look at the top video boards. And in the fall, we'll introduce a comprehensive suite of Windows-application-based tests, as well as new versions of our Winbench tests that will incorporate our increased knowledge on profiling Windows applications.

Understand that no benchmark test is perfect. Any test (applications-based or synthetic) that produces a single number is by definition giving you an average determined by a particular style of use. If you use different applications, or the same ones in a different way, your performance might vary. You need to look behind the test to understand the real performance.

Video card makers need to concentrate less on test scores and more on how their boards work in real systems with real applications. That way, everyone benefits. □

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Startling research by a university optometrist.

In the early 1980s, Dr. James Sheedy, founder of the VDT Clinic at the University of California at Berkeley, noted that most of his patients complained of eyestrain, double vision, nearsightedness, and other vision problems directly related to their use of video display terminals.

Wondering if this were only a localized problem, Dr. Sheedy recently conducted a nationwide survey of over 1,300 optometrists. Results? 14% of their patients suffered from similar VDT-related problems, translating to more than 10,000,000 patients nationally.

A prescription for reducing your risk.

Research has not yet indicated how many CVS sufferers endure permanent symptomatic prob-

lems. Certainly, however, CVS poses potential long-term risks to corporate productivity. Yet simple action can significantly reduce these risks.

Doctors across the nation recommend a three-step prevention program. First, all computer users should undergo a thorough eye examination by an eyecare professional. Vision must be corrected precisely since computer tasks are visually demanding. Next comes a survey of users' physical environment to determine proper computer placement and lighting. Finally, the doctors prescribe Glare/Guard® glass computer screen filters to greatly increase contrast and reduce glare — primary causes of CVS.

One might think that any screen filter (there are several on the market) would serve this purpose. Alas, not so. Only *one* screen filter has met the strict standards for Acceptance by the American Optometric Association and is prescribed by optometrists. Glare/Guard.®



Meets AOA specifications
for VDT glare reduction

To get your Free CVS Risk Analysis Kit call 1-800-949-5053.

This free kit takes you step-by-step as you examine your own computer environment. After all, the risks to you, your personnel, and your company could be great.

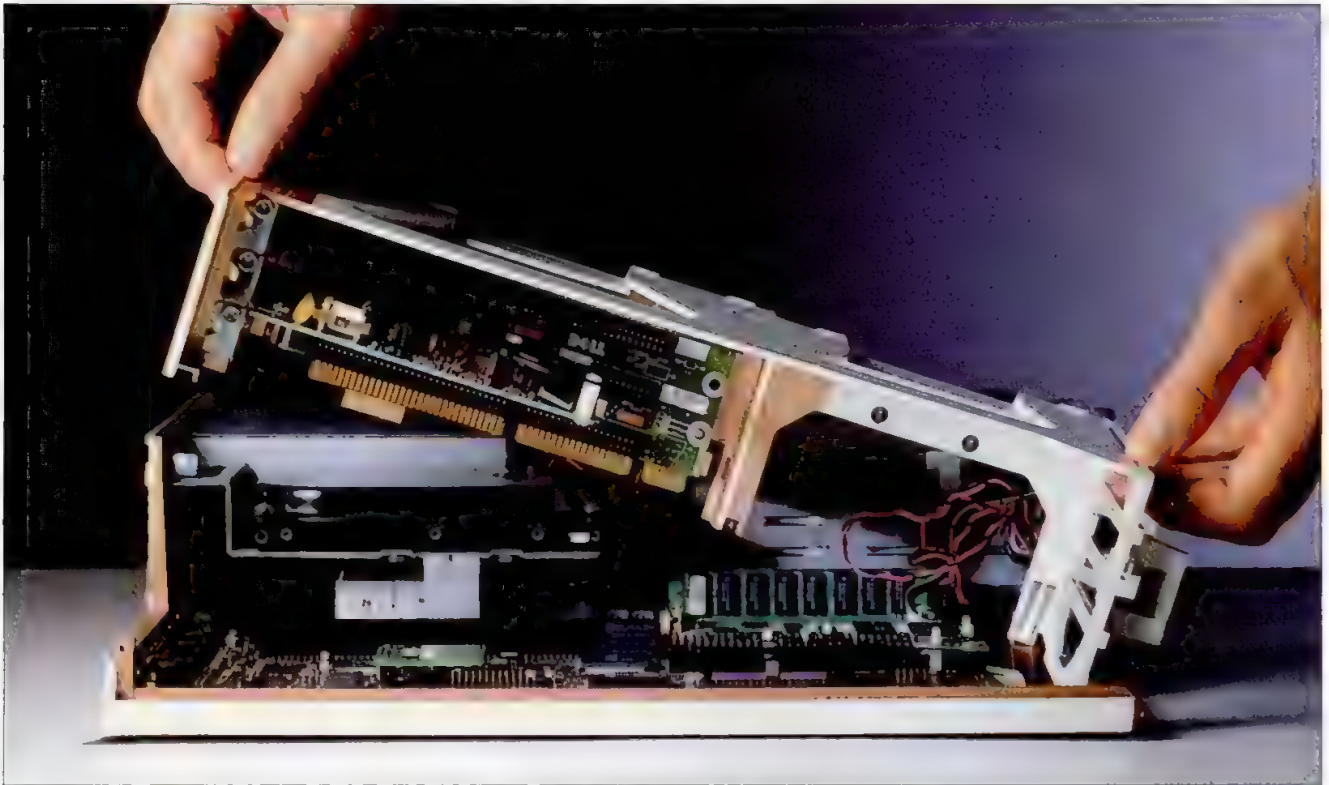
That's why the more you look into CVS and Glare/Guard® protection, the more clearly you'll see why preventing CVS is a healthy approach to take.

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CIRCLE 223 ON READER SERVICE CARD

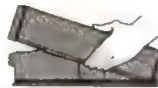
PRETTY EASY.



DELL 486/L SERIES



The Dell® 486/L has embedded diagnostics that can identify a problem component just by pushing the reset button twice. Even if a major component like the monitor or hard drive isn't working, a video display or beepcode will tell you the exact problem.



The Dell 486/L comes apart easily by first taking out two thumbscrews and removing the chassis cover. That's right, you don't need a hammer. Crowbar. Or a chainsaw.



Just push two buttons (you won't need an M.I.T. degree for this either), unplug two cables, and slide out your diskette drives for easy upgradeability or service. Or to add a tape drive or CD-ROM drive.



Then all you do is remove one tiny, little screw and pull out the entire card cage to add different user upgrade options like video memory. You can also add cache. Add Pentium™ technology. Change the processor. Or even swap out the system board. A child could do it. Or even your boss.

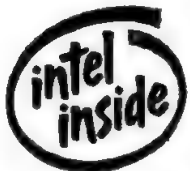


Or if you want to get to your hard drive for easy maintenance or for an upgrade, just take out another screw, unplug two cables, and snap it out.

If you need to remove a hard drive on a Compaq ProLinea System, it's not a pretty picture. And getting to the system board can be downright frightful.

Not so with the Dell 486/L series. In fact, it's the world's easiest PC to take apart. To remove the hard disk of any one of the L Series systems, take out one screw with a standard screwdriver. Access the Dell system board just by removing our unique expansion card cage, with network cables intact.

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PRETTY UGLY.



COMPAQ PROLINEA

T15 Torx screwdriver. (No, your local grocer probably won't have one.) And to access the system board, should you decide to accept this mission, you may have to disconnect all of the cables, then remove the expansion cards, then replace the expansion cards, then reconnect all the cables.

Dell also has embedded diagnostics that can run even when the system won't boot. You'll never waste your time searching high and low for the diagnostic diskette that came in the box.

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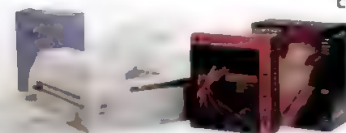
The ScanPartner Plus gives you the ability to electronically file documents, eliminating the need for those bulky rows of file cabinets. It's like getting free office space with each scanner you buy.

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CIRCLE 179 ON READER SERVICE CARD



Bill Machrone

Seizing the Moment

It's been two years. A good friend of mine continues to dither over which camcorder to buy. First it was a standards issue: VHS or 8-mm? After it became apparent that Hi-8 was the way to go, he was further paralyzed by the features war. Cam-

corders weighed four pounds yesterday, they're three pounds today, and they'll be two pounds tomorrow. Prices of the older technologies will continue to fall. The camcorder version of Machrone's Law (the computer you want always costs \$5,000) is that the camcorder you want always costs \$1,800. That's the point at which all new technologies enter the market.

So my friend has missed taping the big events in the first two years of his son's life, and now Number Two has arrived. As if on cue, Sony and others have introduced a plethora of new features, and rumors abound about even more to come. What to do? Wait for image stabilization prices to fall below \$1,000? Pay through the nose for faster focusing and a color viewfinder? My advice: Buy *something*! Get some use out of the technology! Carpe diem!

The situation with PCs is no different. You can get a great deal on a 486DX2/66 clock-doubled PC with local bus and all the trimmings, but maybe you should wait for Intel's clock tripler. . .or faster video cards. . .or maybe they'll start throwing in that second megabyte of video RAM for free. Maybe you should wait out a full generation and then get a good buy on the second wave of Pentium machines.

Of course, PCs have a critical advantage over camcorders: You can upgrade them. That's the good news and the bad news, since upgrading tends to move the bottleneck around. You have too little disk storage, so you opt for a bigger, faster hard disk. You fill it up with new, state-of-the-art graphics programs and the screen is too slow. You buy an accelerated video card and the high-resolution drivers tempt you to buy a bigger monitor.

Then you realize that all these high-speed peripherals are sitting around waiting for the CPU. Along the way, you throw in more memory and a CD-ROM reader. By then you're out of disk storage, so you start all over again.

But wait! Can't you compress the drive with Stacker or DOS 6 and save yourself a bundle? It depends. If you're heavily graphics-intensive, you may find that compression programs buy you very little. Many graphics file formats are already heavily compressed. If you were hoping to carve out big hunks of space for .GIF files, you'd find that they're uncompressible. So are .ZIP files. (You can get nearly a 2-to-1 compression ratio out of most program files, and anywhere from 5-to-1 to 8-to-1 for text files, but don't expect more than 2-to-1 overall.)

There's never an easy cure for system bottlenecks. Too many visits to the aftermarket will cost you more money than you would otherwise spend on an entirely new machine. You'll also have inactive, wasted components on the motherboard. Worst, you'll invite the dreaded spectre of incompatibility. For better or worse,

your system as delivered from the vendor was integrated, and at least all the parts worked with one another. When you start larding it with drivers, you're moving into uncharted waters. Yes, you should upgrade when you have a specific mission to accomplish that can be addressed only by hardware. Buy that accelerated video card when you need to see a 1,024-by-768 view of the world and you know that the rest of the machine is adequate to the task.

GLUDY CRYSTAL BALL

I was talking with another friend the other day, as she



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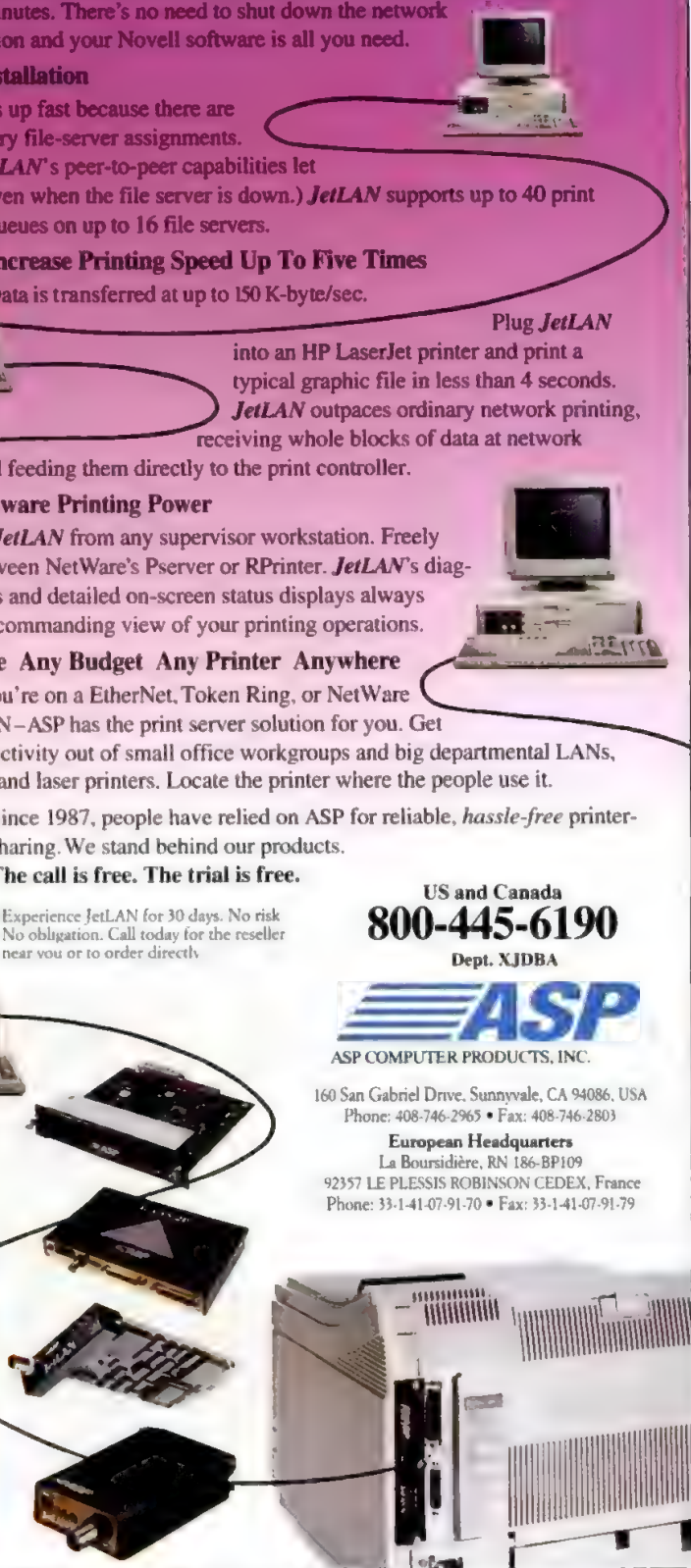


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Bill Machrone

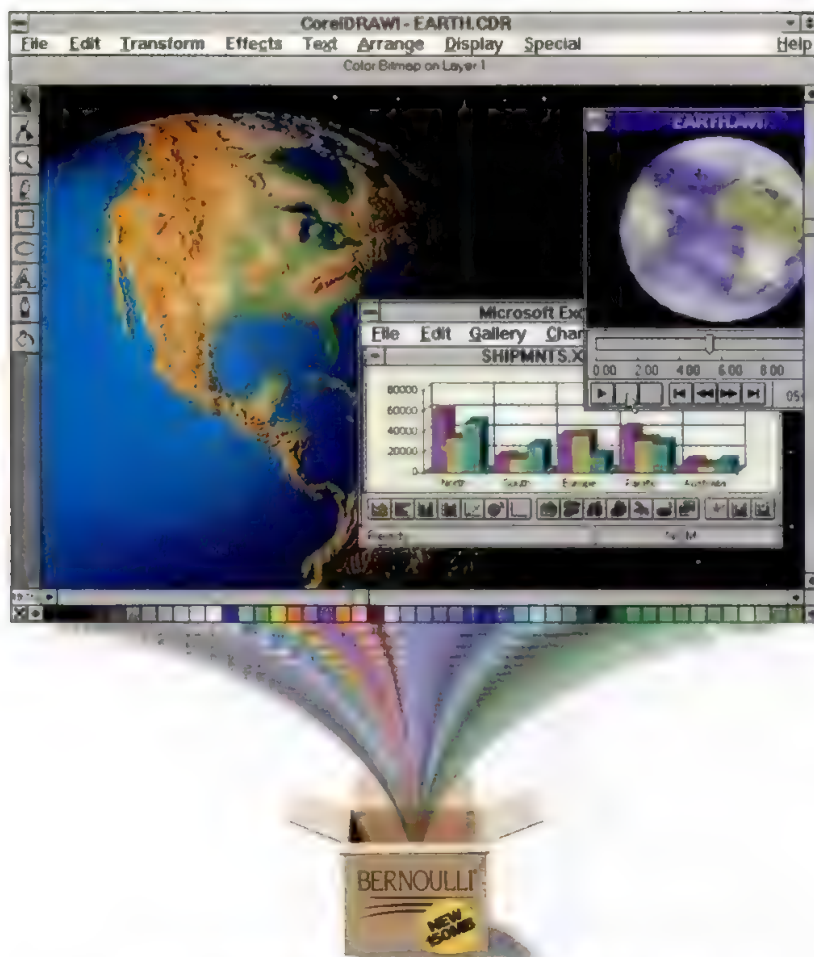
was about to order a new system. Her goal was to buy something that would last her three years. She was making all the right moves, getting a 486DX2/66, 16MB RAM, half a gig of hard disk, local-bus video with 2MB VRAM, and a CD-ROM. That's exactly the right machine—the top of today's market. I wish I shared her confidence in its staying power, though. I fully expect that in three years we'll look at that 66-MHz 486 and smile indulgently at its lack of performance. By then, Intel will be well into the P-6 family of processors (successors to the current Pentium). Typical systems will have 64MB of memory, maybe more. (I just had a flashback to my first system, circa 1976, when I didn't find it necessary to go for the full 64 kilobytes of RAM!) Disk storage three years hence will probably start at a gigabyte and spiral upwards from there.

Both VESA and PCI will be history by then, replaced with faster local buses. Video capabilities will have moved far beyond today's paltry capabilities. Every machine will support photo-realistic imaging in 16 million colors and full-motion video. Today's Video for Windows will look crude and amateurish by comparison. Some kind of compression chip will be on the motherboard. It could be an Intel DVI chip, it could be an MPEG chip, or it could be a general-purpose DSP programmed for one or more types of compression.

Networking may finally make it to the motherboard—but then again, maybe not. Local-bus network interface cards will be commonplace by then, and 100-megabit technologies on unshielded twisted-pair will be coming into general use. Connectivity is one of those areas where the options are so broad and the pace of technology is so great that it seems destined to remain on an add-in card forever.

NO GUARANTEES

Nothing in my three-years-out scenario is guaranteed, and I may be vastly underestimating progress in the meantime. Should my friend hold off and wait for the new features? Absolutely not. There's too much at stake today, too many software applications that need the state-of-the-art machine. Of course, if you don't care about the state of the art, if you're just doing basic word processing and printing Courier type on white paper, I've got an 8-bit 64K system that you might be interested in. □



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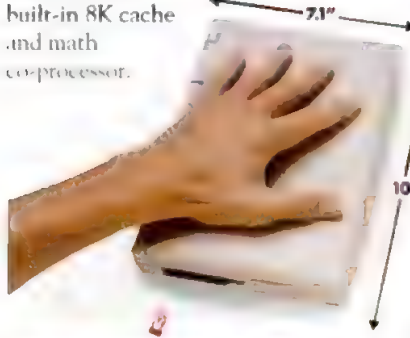
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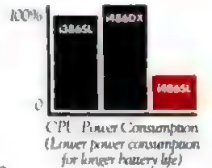


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Removable Hard Drive	Yes	No	No	No	No
RAM (standard/with upgrade)	4/20	4/16	4/16	4/16	4/16
PCMCIA Type II Slot	Yes	Yes	No	Yes	No
Backlit VGA Display	Yes	No	Yes	Yes	No (CGA)
Battery Life	4	3	3	3.5	4
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Full-size, Full-Travel Keyboard	Yes	Yes	No	Yes	No
DOS/Windows/Optional	Yes	No	Yes	No	No
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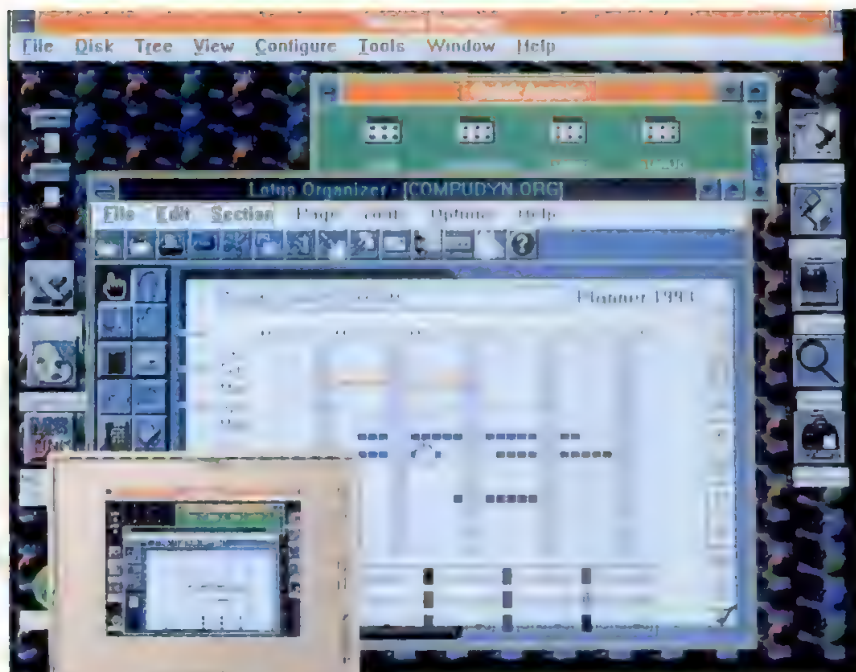
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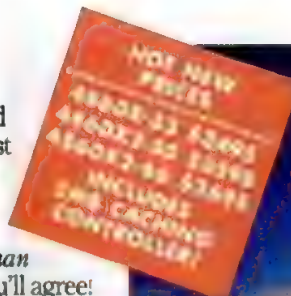
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John C. Dvorak

Crazy Mistakes, 1993 Edition

You know what we'll all miss when the perfect computer comes along? The crazy mistakes people make when they first start using PCs. I've been relating some of these wild stories for years. Classics include the one about the brilliant guy who

uses a magnet to stick a floppy disk to a refrigerator or the secretary who staples a floppy onto a letter. Duh. We've all heard about the Einstein who cuts up a 5.25-inch disk so it will fit into the 3.5-inch slot. But have you heard the one about the yo-yo who never used his hard disk because the manual kept telling him to use the "fixed" disk? He figured his recently repaired floppy was the "fixed" disk!

Most crazy mistakes are a result of simple misunderstandings and semantics. (Press any key. . . "Hey, I don't have an 'any' key!") Now for a few crazy mistakes I've been saving up.

Here's an amusing story that actually took place in the hallways of—oh, let's just say it happened at a leading computer magazine whose logo is big and red:

A brand new employee was told that it's always important to check for viruses. After spending a few days wiping each floppy disk with a napkin before putting it in drive A:, the poor guy finally went to his boss and asked for some antivirus spray. Listerine anyone?

Daniel Klaussen has a collection culled from the annals of a technical service department. Customer: "I can't open my data file."

Tech: "From the DOS prompt, type DIR SPACE filename DOT STAR." Lots of typing is heard. Customer: "'Invalid parameter.' Hmmm! How did you spell star?"

Here's another winner from someone with a word processor: "I can't seem to delete this file. It's called 'Cunnamed.' Can you tell what's up?" Tech: "The file is called 'Unnamed.' That square bracket is not the letter C!"—the [Unamed] file.

From Exact Automation in the Netherlands comes a screwball story from Paul van Keep:

"Hi, John. This is a great one that came from our support department. A lady called to complain that every time she used the computer, garbage would appear on the screen after a while. The support people checked her hardware, DOS version, everything. But there didn't seem to be a problem. So someone went to visit her to check what was wrong. The lady had two problems. She didn't see very well, and she had a rather voluptuous bosom. Every time she had difficulty reading text on her screen, she would lean toward it to take a closer look. Turns out something kept hitting the keyboard!"

Well, at least they kept abreast of the situation.

Paul van Keep also likes to tell the story of the neat freak who forced his floppy disk into a typewriter so he could type on the labels so it was "really neat".

Then comes this pathetic note from Andrew Bokelman:

"John, not exactly a crazy mistake, but. . .there is an analyst at work who draws so many ridiculous conclusions they could fill a book. Today, at work, an associate got a 'drive C: full' message while using dBASE. I went over to look and noticed that there were 2MB left on

the hard disk. The analyst came over and offered the following explanation of what was causing the problem.

"'When you start a program, it's loaded into memory while leaving the original on the disk. This doubles the space taken by the program and causes the hard disk to run out of room.' He wasn't kidding, either!"

Makes you wonder where these guys come from.

Now let's dig up some crazy mistakes from OS/2 and Windows users. There should be some great ones!



Fold that floppy! Spray for viruses! Display your magnet collection next to your PC!

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InfoWorld - Reader's Choice 1992

"Highest Overall Rating"

NSTL/Software Digest Ratings Report of Windows-Based
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"Technical Excellence Award"

PC Magazine - Networking/Communication Product

"Best Networking Software or Hardware"

PC Computing - MVP Award

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BYTE Magazine - User's Choice Award

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Inside Track

T

he Never-Ending Pentium Gossip Continues Dept.:

Intel has promised to ship a few thousand Pentium processors by year's end, and I suspect it will. But in the process, there is a **huge debate** raging at the company between the manufacturing people and the marketing people. According to one insider, the manufacturing people believe that it's **not worth the hassle** to make any Pentiums until the die size is reduced. As it now stands, the total income per silicon wafer that can be generated from those few Pentiums that meet specifications doesn't hold a candle to the income that the dinky (and totally debugged) 486 chips can make per silicon wafer. Unless the worldwide demand for 486s dries up, there's a ton of cash waiting to be harvested.

AMD knows this and recently **got lucky** by winning a court reversal on its original 486 clone. Expect to see AMD get on the cash cow. Sources tell me that total Intel 486 production is already **a million per month** and climbing. With such numbers, don't expect a 586 push until mid-1994.

The sleeper in all this activity is IBM with its **clock tripler**. IBM intends to release a clock-tripled 486 chip (33 MHz external, 99 MHz internal) before Intel rolls out the DX3. Some insiders believe that IBM will enter the microprocessor business seriously enough to supply all the CPUs for the over 5 million PS/1 and PS/2 machines it sells. IBM figures it can **up the performance ante** and head off Compaq before the latter passes IBM in unit sales, as it has promised to do.

More IBM vs. Microsoft Shenanigans Dept.:

Where was the IBM version of DOS 6 when the Microsoft version was shipped? If you talk to IBMers they'll tell you that Microsoft, which was supposed to supply some key code to IBM, **kept stalling IBM** with lame excuses along the lines of "the dog ate my homework" to make sure IBM would again have to play catch-up. By the time DOS 7 comes out, expect to see IBM **ditch Microsoft** and its code and instead use what it learned from its excellent "better DOS than DOS" code found in the OS/2 kernel. A fellow who is contracting with IBM told me that, besides a tight new DOS with smaller code size, there will be "something that will hurt Microsoft." He didn't say what, **moaning** that he was under nondisclosure.

While nosing around to find out what this "some-

An IBM insider led me to Sun Microsystems, where technology is being developed to run Windows apps without Windows. Bill Gates is scared silly, and it's likely that IBM has similar plans for OS/2.

thing" was, I was told by a company insider to look at what Sun Microsystems was doing to get a hint of what might be happening. This led me to the so-called **WABI** (Windows Application Binary Interface) technology, which will allow Sun Unix to run Windows applications. Gates is **scared silly** over this kind of thing. It's possible that IBM has developed a **similar Windows runtime system** that will allow users to run Windows applications without the Windows shell. Best estimates have it that IBM is paying a **ridiculous \$22 a copy** for the Windows code in OS/2. IBM would love to ditch that royalty somehow, and this is the most logical way.

Meanwhile, anyone trying OS/2

or NT using the **dual-boot** technique, whereby you can choose at boot-up which system you want, should **avoid MS-DOS 6.0** and its disk doubler. A letter received from Todd Natkin makes it clear: "Has anyone else noticed that Microsoft's reason for getting this lame DOS upgrade out the door was so that users would create compressed partitions that would not be usable under OS/2? The OS/2 dual-boot option is by far the favorite way to try out OS/2 on a FAT drive. By encouraging the use of DoubleSpace, MS is preventing users from testing OS/2 2.1 on their present files or Windows programs; the files can't be read and the programs won't migrate. Shouldn't someone in the media have mentioned this to millions of potential DOS 6.0 users before the upgrade was released?"

The Greatest Kid's Game Ever Dept.: Look no further than Humongous Entertainment for some great kids games. I mean great. If you have children 3 to 8, you know how much they want to play adventure games, but they get hung up on the complexity and the incessant required reading. Putt-Putt Joins the Parade—the company's first offering—has a cute talking car as the main character. The adventure puzzle is very beatable for little kids, but (parents take note) **quite time-consuming**. The kids stay interested because of the **stunning animation**. A CD-ROM version is available. The game sells for around \$50.

Genuinely Weird Developments Dept.: If you haven't heard, the famous **Wailing Wall**, Judaism's holiest shrine, into the cracks of which people cram written prayers, can now be **reached by fax!** The wire services report that an employee will stuff your faxed prayer into a crack in the wall. If you're interested in this religious development, call (from the U.S.) 011-972-2-612222. Will wonders never cease? □

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THE TRASH.



Curiously, some of what's stored on your floppy disks would be better lost than saved. Tiny bits of dirt and debris can enter a disk uninvited, only to threaten your most precious data.

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SONY.

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Jim Seymour

Progress in the Era of 50-Cent Fonts

You'd have to have been living under a rock to have missed the type revolution wrought by Windows and TrueType over the past two years. Adobe's all-but-unchallenged standing as king of the hill, with its Type 1 PostScript fonts, has come

under assault from a thousand directions. And TrueType font prices have fallen through the floor. But if you think it's been bloody so far, wait till you see a new technology coming from a tiny shop in Seattle.

The world of type has gone through epochal changes over the centuries. From the first wooden movable type 500 years ago, we've gone through hand-cast metal type; hot type set on those wonderful, chattering old Linotype machines; the cold-type revolution of film fonts in the 1950s and '60s; and now to the digital era, with fonts stored on-disk as outlines to be built into lines and pages by computers.

Throughout, type has been an expensive commodity. When I specced new faces for pieces I designed in the '60s and '70s, type shops grumbled about paying \$150 to \$200 for the Compugraphic film rolls that included those fonts. That's \$150 to \$200 *per variation* on a typeface, so a job with standard Roman type, plus italic, boldface, and bold ital, could cost the typesetter almost a grand. He then had to hope that other customers would use those fonts frequently enough to let him get his money back before they became passé.

By the 1980s, some type shops felt threatened by our easy access to the first Adobe fonts, but most accepted the reality of digital fonts. And they liked the fact that a whole family of, say, Bodoni now cost them the same \$150 to \$200 that they once paid for every variation in the face.

Then came TrueType and three big bombs from Microsoft blitzes. First, though there's nothing inherently cheap about producing or licensing TrueType fonts, Microsoft put a selection of TrueType fonts in the box with Windows 3.1. That made it

seem to some as though type should be—and in fact might soon be—almost free.

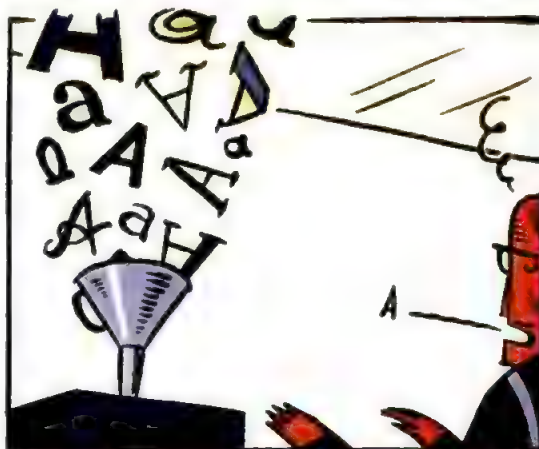
THE SECOND BOMB

Next, Microsoft rolled out its big-selling TrueType Font Packs, the success of which has absolutely terrified the type industry. We've always had cheap type, but it was usually awful. Now, Microsoft was selling superbly crafted typefaces, in their original names, under license from the foundries that originally created and thus owned them, for maybe 50 cents per font at street prices.

An avalanche of TrueType font packs soon followed from other vendors, driving the price per font even lower. The quality rarely matched that of the Microsoft packages, but many of these other font packs met the "good enough" test and sold in huge numbers. Adobe, Agfa, Monotype Typography, and other big type houses around the world did not know what to make of the phenomenon. To a large extent, they still don't.

How, these companies ask, can they be expected to keep creating new typefaces when the potential return is so small? It's a fair question: You don't hire great type designers for chump change.

Microsoft dropped its third bomb on the type business with the embeddable-type technology that's part of the TrueType model. This technology allowed fonts used in a document to travel with the document from one PC to another, so that the document could be displayed and edited on a new machine, even if the fonts in it had not been installed on that machine. In the read/write flavor of embeddable type, the fonts are permanently loaded on the new machine, so that they stay be-



Thanks to new technology, fonts that once cost hundreds of dollars can now appear on any computer for pennies.

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Jim Seymour

hind, so to speak, long after the document is gone.

Microsoft hoped to set an example for the software industry when it licensed and put in the box with PowerPoint 3.0 for Windows several read/write embeddable fonts. Type foundries feared this practice would become commonplace, but other software developers have largely ignored that expensive path.

Now, though, brilliant technology from some of the people who helped create Aldus PageMaker is about to shake up the type business as never before. Ben Bauermeister's feisty little ElseWare shop in Seattle first showed its Infinifont technology in public at April's Seybold show, where it scared the hell out of type mavens. You'll see it licensed to software and perhaps hardware vendors very soon.

ElseWare (206-632-3300) has run 200 of the most popular fonts through a process that reduces them to relatively short numeric codes. When a document is loaded into an application on a PC on which Infinifont is installed, Infinifont checks to see which fonts are in the document and then looks up those fonts, or their very close equivalents, in its internal tables. Presto: The document appears on-screen, or emerges from your printer, looking just as it did when it was created—without requiring you to have those fonts on your PC.

This real-time generation of fonts on the fly saves enormous amounts of space on users' hard disks. Infinifont and its 200-font database take up about 1MB of disk space; as TrueType or PostScript outlines, those fonts would take ten times as much space.

On that level, Infinifont is just a very nice, transparent document-exchange system. But a separate retail product coming soon from ElseWare will let users use any font in Infinifont's database. And that could be a stake in the heart of the expensive type market.

As the catalyst for this change, PC users certainly should credit Microsoft with having first made high-quality type more accessible. If type foundries suffer from progress, users also gain from it—at least for now.

But I worry about the future of the type design business. Almost all of the zillions of 50 cent fonts released so far are knock-offs, or licensed versions, of existing typefaces. Who will provide the capital to support the creation of new faces? □



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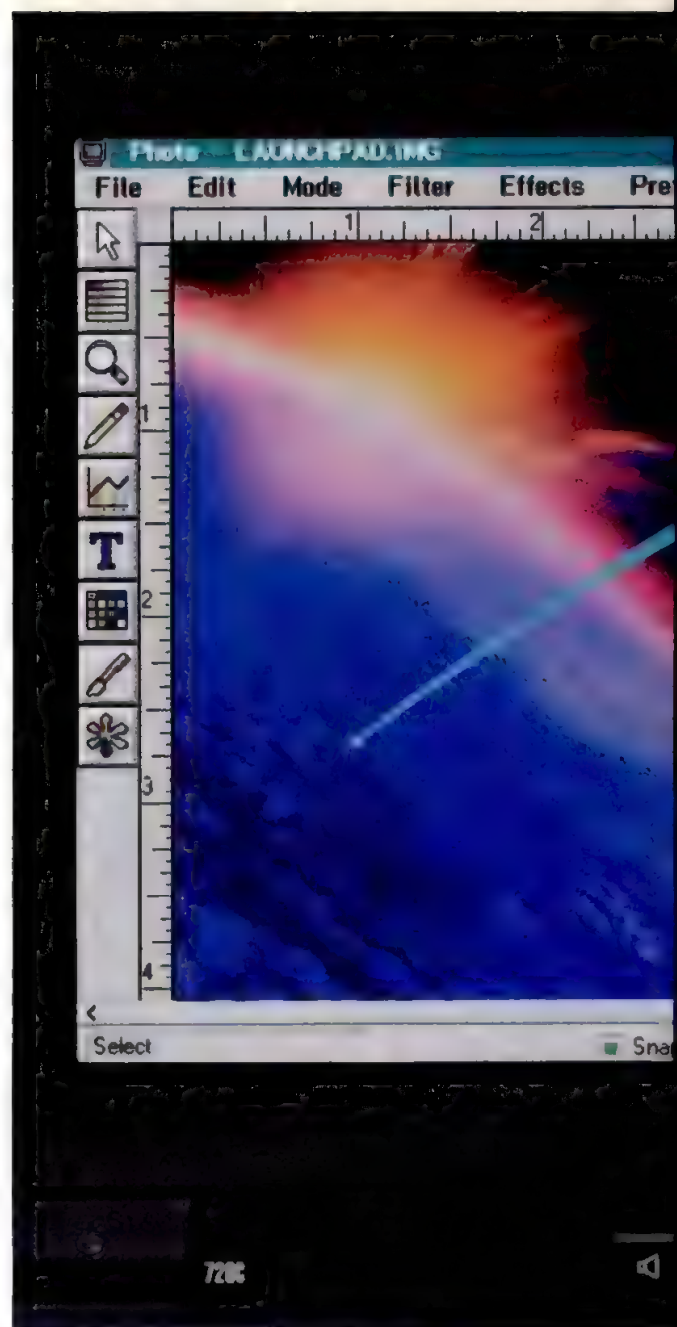


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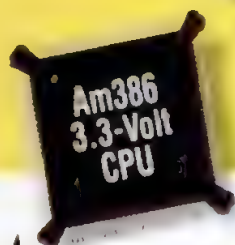
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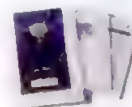
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Bill Howard

The Trouble with Communications

Digital superhighway, my foot. When it comes to moving data, America's PC users need some paved two-lane roads first. Some people talk of moving data via today's phone wires at 1 megabit per second among computers thousands of miles

apart; most would be happy just to get their modem, comm software, and PC to work together at any speed.

MODEM DRIVERS

You wouldn't buy a word processor that required you to tell the printer which escape codes to use for boldfacing and underlining, yet that's exactly what many comm programs make you do. If you blindly pick "Hayes modem" on your software setup, there's no guarantee you'll make a connection, even though virtually every modem made today claims Hayes compatibility.

The solution: Each modem should have a modem driver, which would work like a printer driver. It should be stored in flash memory in the modem, although it could be on a disk. A communications program would interrogate the modem and automatically configure itself. Senior networking editor Frank J. Derfler, Jr. proposed such a driver standard, and dozens of vendors expressed interest, but everyone waited for someone else to make the first move. We're still waiting.

SLOW UARTS

Your PC can move data along the bus at several Mbps, but the UART, the connection between the bus and the serial port, runs out of gas at much lower speeds—so low that a 9,600 bits per second modem using data compression may drop a few bits. So if high-speed communications is important, insist on the 16550AFN UART.

ON-LINE OUTDATED

Today's 14,400 bps modems can compress data 4:1 for a potential throughput of 57,600 bps, or just under one second to transmit this 4K column. But if you were to send this col-

umn through an on-line service, it would actually take about 10 times as long. That's because most on-line services use 9,600 bps modems with data compression turned off. Not much you can do here, except tell the on-line services: Get with the program.

STATUS LIGHTS?

Internal modems are cheaper, less obtrusive, and free from the limitations of the UART. But they don't have status lights. It's high time some enterprising system vendor offer a built-in modem with status lights on the PC's case. Alternatively, some maker of internal modems should offer a status-lights option: a matchbox-size accessory connected to the back of the modem with a two-foot cable; it would attach to your monitor or system unit with velcro.

What most ails the communications industry is the lack of a strong leader that can set and enforce de facto standards. Gripe if you want about Microsoft and Intel Corp., but their all-powerful status does provide unambiguous standards for operating systems and platforms. For example, perhaps Microsoft should publish a stan-

dard configuration and setup string for Windows-ready modems or bundle modem drivers the way it now bundles printer and mouse drivers.

Ultimately, communications software should go away as an app and just become a service. Your PC should know what's available at the other ends of phone and network cables, know whether or not you're currently connected, and be able to exchange information in the background. No muss, no fuss. That's the future. For now, Federal Express and fax machines are in no danger of extinction. □



Most users would be happy just to get their modem, comm software, and PC to work together.

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as a whole, and a street price as low as \$1,450, and it's hard to imagine a better buy.

An excellent choice for any PC desktop

clips.

fast!

(scanner excellence), only one—
Hewlett-Packard's ScanJet IIc
excelled in both categories

showed considerable dif-
ference between the fastest and slowest machines on
the market at 300 dpi, for instance,
HP ScanJet IIc scanned our text page in 22
seconds while its competitors required
30 seconds to complete the same task.
You can expect to wait roughly
twice as long for graphics scale as for gray-
scale. This difference might
not seem like much, but over the
course of a year or so. With a slow scan-
ner, it could cost you 2 minutes or
more.

PC
MAGAZINE
EDITORS'
CHOICE

April 14, 1992
HP ScanJet IIc

as made scanning as simple as possible.

GRAPHICS
COLOR FLATBED SCANNERS

But Hewlett-Packard Co. has gone
out of its way to make the ScanJet IIc an
enticing buy, no matter what the
application.

Past HP scanners have

PC Computing
MVP
WINNER



HP ScanJet IIc



HP ScanJet IIfx

We'd hate to brag. So we'll let the PC
press do it for us.

Both *PC Magazine* and *Publish* called the
HP ScanJet IIc the *Best Color Scanner* for
1992. While *PC Computing* named the
black & white/gray-scale HP ScanJet IIfx
the *Most Valuable Product* of the year.

Speed. Simplicity. And accuracy were all
applauded. It's no wonder. HP's single-
pass scanning delivers both lightning-fast
speed and precise color registration.
TWAIN support allows scanning without
having to switch between applications.
And HP AccuPage technology with 400-
dpi resolution can tackle the toughest
OCR challenges. What's more, capabilities
this advanced are now even more afford-
able. List price on the HP ScanJet IIc has
just dropped to \$1,599. The HP ScanJet IIfx
is just \$879.

Impressed? Don't just take our word for it,
or even the PC press's. Attend one of our
scanning seminars that will be held April
through September, 1993. To find out more
about the HP ScanJet IIc and IIfx or semi-
nars in your area, call 1-800-SCANJET,
Ext. 7365*. And judge for yourself.



**HEWLETT
PACKARD**

The New

Intel's Pentium microprocessor is now the standard of comparison. We examine the first seven Pentium-based systems to see if they will satisfy today's power-hungry users—and tomorrow's.

by Jim Seymour

It's true: Pentium PCs really *are* going to change the PC business.

Not necessarily right away—though several of the first Pentium-based machines we review here are systems you'd love to have on or beside your desk today—but certainly over the next year or two. And the changes will go much further than simply speeding up your spreadsheet recalculations and screen redraws. More than merely the sum of its impressive technical merits, Pentium technology will alter the structure of the computer industry itself as Intel attempts to invade RISC's turf—the technical workstation market. In some cases, RISC will carry the battle directly to Intel's turf—the CPU market.

Our cover story in the issue of April 27, 1993 looked at the technical side of the Pentium and at how other chip makers are likely to respond to the emerging technology. Recently, we looked at engineering prototypes from some of the PC world's heavyweights. That left us salivating at the prospect of getting our hands on real Pentium computers. Now, with seven actual Pentium PCs in

hand for testing plus a look at a Pentium-based monster workstation/server from NCR (see "NCR's Multiple-CPU PCs"), we've successfully satisfied our lust for power—at least for the time being. Without a doubt, these are hot machines, and they're going to be tempting choices for power users with a level of purchase-order authority to match.

We looked at two classes of Pentium machines: workstations and servers. Since we wanted to focus on the CPU, we took a twin-track approach to configuration. Our filter for workstations specified Pentium-based PCs with a minimum 12MB of RAM, at least 300MB of storage space for data, a 15-inch monitor with a Super VGA graphics adapter, and DOS 5.0 and Windows 3.1 installed. For servers, we asked for at least 16MB of RAM, between 500MB and 2GB of storage space, and NetWare 3.11 installed. We received three workstations, from Compaq, Digital Equipment Corp., and Unisys; and four servers, from Acer America, Advanced Logic Research (ALR), Hewlett-Packard, and IBM.

Our workstation tests focused on applications perfor-

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Standard



HIGHLIGHTS

Pentium PCs

THE PENTIUM IS THE FASTEST, most powerful microprocessor in the PC world. Superscalar operation, dual pipelines, and 64-bit operation add up to consistently superior performance, regardless of whether a system is designed as a network server or Windows workstation.

HEAT CONTINUES to be a concern for designers and engineers of Pentium-based machines. Some systems in this roundup contain large heat sinks; others have chip-mounted fans, and one PC has both.

60 MHz AND 66 MHz are the current speed limits for Pentium-based systems, but the chip line should be able to process at speeds greater than 100 MHz sometime soon.

WORKSTATION OR SERVER, the units here are all high-powered systems with performance about 75 percent ahead of the best 486-based PC.

formance. We added a new applications suite to our usual Hardware Benchmark Test series and Winbench 3.11 tests. This suite runs a series of automated and tightly controlled tasks under Excel 4.0, Superbase 2.0, Ami Pro 3.0, and CorelDRAW 3.0. For the first time, we tested performance both with and without a software cache installed. We used a 2MB Microsoft Windows 3.1 SmartDrive cache, a high-performance product and probably the most widely used cache program, because we believe most users enhance disk performance with a software cache. (For further explanation, see "What the Numbers Mean.") We tested the servers in a 32-system network of 20-MHz 386 systems running NetWare 3.11. We ran them through our NetBench 4.0 tests using a variety of file-size and block-size parameters to simulate LAN activity.

EARLY ADOPTERS

Regular readers of *PC Magazine* will immediately notice two unusual things

THE IBM PS/2 SERVER 95 is the first PC to break the barrier of 30 million processor operations per second. Its Streamer network interface adapters provide excellent I/O throughput over a range of file and block sizes.

THE COMPAQ DESKPRO 5/66M'S 128-bit data path helped it rise above the rest with a superior memory benchmark test score. The Deskpro was able to move data from memory 20 percent faster than the next best of the group.

486-TO-PENTIUM is possible through a processor-board upgrade where available, P24T overdrive CPU when it becomes available, and eventually through replacement motherboards. Each upgrade path to Pentium has its positive and negative aspects; ultimately, however, buying a full-scale Pentium PC will offer the best results.

THE UNISYS PW² ADVANTAGE Plus 5606 machine was 20 percent faster

than the other Pentium systems at accomplishing software tasks in a simulated multitasking Windows environment.

PENTIUM LOOKING A LITTLE SLOW?

We offer two solutions: Consider a multiprocessing system that will use from 2 to 16 Pentium CPUs, or wait until 1995 for the expected introduction of the P6.

PCI (Peripheral Component Interconnect) architecture, an emerging local-bus system, meshes nicely with the Pentium and offers potential advantages over VESA's VL system and proprietary arrangements. PCs that combine PCI with the Pentium should be available by fall.

THE BEST PENTIUM systems combine a wide data path with efficient external cache designs and the ability to perform quick burst read/write sequences.

about this list of machines: It's a lot shorter than our usual tally of PCs for comparison tests, and the makers are all big names in the computer business. These departures reflect the enormous demands of Pentium engineering and the intense shortage of Pentium chips. It takes a sizable company to fund and get under way quickly an engineering effort capable of producing a machine based on a microprocessor as complex as the Pentium this soon in the game.

We expect to see three waves of Pentium PCs hit the market this year. These first seven machines form the vanguard. All are based on 486 designs to some extent, but they deliver a lot of the poten-

tial power of the Pentium for your (substantial) investment. Soon, we'll see a much larger wave from a wider variety of vendors. These, too, will likely be based on 486 designs, and the degree to which they deliver on the Pentium's potential will vary considerably depending on the engineering sophistication, time, and care invested in each design.

We expect a second generation of Pentium machines to be shown later this year—computers designed from the ground up to satisfy the Pentium CPU's hunger for data. These systems will have highly (and expensively) optimized caches, memory, I/O, and other subsystems required to truly exploit the power

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▶ EDITORS' CHOICE

- **All are impressive, but it's too early to make a choice**

Intel has built into the Pentium. Though the first systems, reviewed here, are undeniably fast and powerful—on average, they deliver about 75 percent better performance than their makers' current top-of-the-line 486DX2/66 systems—the class of Pentium machines coming late in the fourth quarter will deliver even more. Some may be ready to show at Fall Comdex in November, but the actual delivery may take a bit longer.

For desktop machines destined to be used mainly as standalone CAD, desktop publishing, or financial-analysis workstations (with a network connection for file-sharing), that chronology may not be so

*In another few months,
we'll see a much larger
wave of Pentium-based
PCs from a wider variety
of PC vendors.*

important: Any of these first- or second-generation machines will work well and offer a quick payback. But for those seeking truly high-performance servers, machines that take still better advantage of Pentium may be worth the wait.

REALISTIC EXPECTATIONS

With every new-generation chip that has appeared, the name of the game has been speed and raw computing ability. Early press reports on the Pentium chip talked optimistically about increases in general computing power in the neighborhood of fourfold to fivefold over the 486DX2/66 chip. Those reports weren't in error, but misguided: The fourfold to fivefold gain was realized in the arcane area of floating-point operations, an area that will not mean major performance increases for most PC users.

The improvement Pentium offers over previous Intel x86 CPUs lies in its floating-point math speed. Intel worked hard on cranking up floating-point calculating speed in order to counter RISC-chip producers, which it came to perceive as very serious threats to its hegemony

When looking at systems built around the latest and swiftest microprocessors available, keep in mind that being first out of the gate counts for a lot. All past generations of Intel's x86 family initially drew attention and close scrutiny as the power systems

of their day. More than just a marketing advantage, the ability to build first is an indication of a manufacturer's superior design and engineering capabilities. All vendors represented here possess the engineering resources to make it to market quickly with a quality high-end system.

Regardless of whether they were designed as servers or Windows workstations, none of the seven machines we reviewed disappointed. For being out front and getting it right the first time, all are deserving of praise, but we feel it is too early to give any an Editors' Choice award. Because of both the consistently high level of performance—relative to a comparable 486-based system—and the fact that they are all distinctly separate systems, we found it impossible to choose among them.

The ALR ProVEISA V and Acer-Frame 3000MP can both handle the I/O throughput across a wide range of file and block sizes necessary to make them high-quality file servers. Our tests showed that they will satisfy users across a variety of applications. Each can be upgraded to symmetric multiprocessing with two or more Pentiums—enough to transform these servers into application-class systems.

The Compaq Deskpro 5/66M led the pack with memory scores that were 25 percent above the group average. Compaq's proprietary TriFlex system, based on a 128-bit data path and once the exclusive domain of the company's Systempro server line, makes a successful desktop PC debut here. And with its very good Winmark

video score, the Deskpro makes a superior workstation.

Digital Equipment's DECpc 560ST and Hewlett-Packard's HP NetServer 5/60 are more similar than you might think. While their appearance, purpose, and target audience are at variance, both systems were engineered in association with Intel, and you'd be hard pressed to find another vendor better able to understand the nuances of building a quality Pentium PC. The 560ST is a solid and dependable workstation that is very even tempered—neither startlingly fast nor slow. The NetServer hits all the server hot buttons, from high throughput to a high-quality case to drive-array circuitry to management software.

The IBM PS/2 Server 95 takes the lead in processing power and overall throughput, which is partially a result of the system's Streamer network interface cards. This is not only a quality product, but it signals IBM's return to the realm of technology leader, not laggard.

The Unisys PW² Advantage Plus 5606 achieved the best score on our Windows Application test suite, despite being one of four tested systems saddled with a 60-MHz processor. Add to that its excellent Winmark video score through a proprietary local-bus system, and you have a winner workstation.

It's clear that by late summer, this trickle of Pentium systems will become a torrent. What isn't clear is whether these second-wave systems will be as carefully designed, engineered, and built as these first seven.

over the CPU market because they produced chips that were beating Intel over the head with their superior floating-point performance. The speed of Pentium's floating-point operations is now about four to five times faster than those of the 486, but still pales in comparison with that of most RISC processors.

Unfortunately for the PC user, few general-business PC applications make much use of floating-point math. Some, such as AutoCAD, do include some floating-point routines, but most PC applications live in the much slower world of integer calculations. The Pentium does roughly double the 486's integer math performance, but the payoff isn't nearly as large.

That may change; the Pentium's power seems so seductive to software engineers that many software publishers have already started looking at ways to improve performance by using more floating-point routines. They're also looking at recompiling their applications, which will be necessary to truly wring the most out of the Pentium.

Pentium also means a new definition of the workstation market. The emphasis on floating-point improvements will

probably prove much more important as a strategic move for Intel, allowing Pentium-based systems to make inroads into the technical workstation market, which has up until now been dominated by IBM, Sun Microsystems, Hewlett-Packard, Digital, and other RISC-system ven-

*Though these first systems
are undeniably fast and
powerful, the class of
Pentium machines coming
late in the fourth quarter
will deliver even more.*

dors. By the same token, Pentium's comparatively lower price will lure buyers of expensive RISC workstations.

The key element in this redefinition will be this summer's release of Microsoft's Windows NT operating system, which will run on a variety of platforms—from the traditional RISC systems to personal computers. The result will be that

compatibility will be based on operating system, not hardware.

SPEED-LIMIT GAME

A close reading of the reviews, fact files, and features table entries that follow will show that some vendors are using 60-MHz Pentium CPUs while others are using 66-MHz parts. This dichotomy is based on Intel's yield problems on its Pentium production lines and its desire to sell as many finished chips as possible. No chip maker is able to achieve a 100-percent yield on high-performance microprocessors: At least a few of the chips produced on each silicon wafer are likely to fail one or more critical quality-control tests. That may be due to problems as simple and frustrating as the quality of the silicon wafer itself.

With a truly advanced design such as the Pentium, which is stretching chip-making technology, many factors can cause some chips on a wafer to fail. Pentium marks Intel's descent into the challenging and demanding world of sub-micron semiconductor design. The 486 was initially based on 1.0-micron elements, while the Pentium's traces, or signal paths, are just 0.8 microns wide. (To

Suitability to Task

The Unisys desktop unit and the ALR server led their respective classes, each earning three top marks out of four in our desktop and server Suitability to Task ratings.

DESKTOPS

The rating for **DOS applications** describes the system's ability to run DOS software quickly and efficiently. To earn an *excellent* rating, a PC needs at least a 200MB hard disk drive and a DOSmark score among the top quarter of the reviewed systems.

Windows applications is a more demanding category; the rating indicates how well a PC will operate Windows software. Factors include Graphics and Disk Winmark scores, DOSmark score, the maximum motherboard RAM, hard disk options, the maximum non-interlaced video resolution, the screen size, and the presence of a mouse port. Well-designed systems containing top-flight video controllers and fast hard disks received *excellent* ratings.

Expandability rates a system's potential for growth. Considerations include ease of processor and external cache upgrades, system BIOS, hard disk options, maximum RAM installable on the motherboard, available drive bays and bus slots, and 16550 UART support. The best systems have flash BIOS, and easily upgradable processor/cache.

Workstation replacement rates a unit's value as a replacement for a high-end, RISC-based workstation (such as a Sun SPARCstation), which is designed to handle high-level graph-

ics, CAD and other demanding applications. The rating is based on CPU, disk, memory, and video graphics performance; maximum RAM and hard disk size; and monitor size and resolution.

SERVERS

Scalability rates a server's potential for expansion. Ratings are based on flash BIOS availability, disk capacity, maximum cache RAM, maximum sys-

tem RAM, multiprocessor capabilities, number of open expansion slots, power-supply wattage, processor upgradability, and number of half-height drive bays. Servers judged as *excellent* come with flash BIOS, have drive bays and slots to spare, and possess multiprocessor capability.

The **security/fault tolerance** rating reflects a system's reliability and data-protection features. To earn an *excellent* rating, a unit needs to support most of the following: BIOS password security, front-panel security, a high-wattage power supply, "hot" drive replacement, keyboard security, optional redundant controllers, problem-notification software, remote-notification features (require a modem), and temperature sensors.

Product Name	
SUITABILITY TO TASK	
DOS applications	POOR
Windows applications	FAIR
Expandability	GOOD
Workstation replacement	EXCELLENT

Product Name	
SUITABILITY TO TASK	
Scalability	POOR
Security/fault tolerance	FAIR
Throughput/ small block	GOOD
Throughput/ large block	EXCELLENT

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Benchmark Tests: Pentium PCs

What the Numbers Mean

Among desktop units, the Compaq Deskpro 5/66M managed stellar memory and processor performance, thanks to its TriFlex/PC internal architecture. The IBM PS/2 Server 95, which led all tested machines in processor performance, excelled on many of our network tests, thanks to its lightning-fast disk subsystem.

PROCESSOR AND MEMORY

The IBM PS/2 Server 95 surpassed the other systems on our processor test suite, with a score of 30,215 operations per second.

On the average, the 66-MHz Pentium systems—the ALR ProVEISA V, Compaq Deskpro 5/66M, and PS/2 Server 95—outperformed the fastest 486-DX2/66 designs we've seen by between 70 percent and 80 percent on our processor tests. The AcerFrame 3000MP, DECpc 560ST, HP NetServer 5/60 LM, and Unisys PW² Advantage Plus 5606 run at 60 MHz. Their scores on the Small Mix test—a component of the processor suite representing the instruction mix that fits inside the processor's internal (Level 1 or L1) cache—nearly matched those of the 66-MHz units, as expected. Acer, Digital Equipment Corp., Hewlett-Packard, IBM, and Unisys all used the new Intel 82486 Level 2 (external or L2) cache controller, but ALR and Compaq used proprietary L2 cache setups.

There was little difference among the 60-MHz systems, but we saw noticeable differences among the 66-MHz units. The ProVEISA required six clock cycles to perform a burst transfer from the L2 cache to the CPU in a 3-1-1-1 sequence; the PS/2 Server 95 used a 2-1-1-1 transfer, which gave it a slight edge. The Deskpro transferred data from the L2 cache with an eight-cycle, 2-2-2-2 timing.

The Deskpro's memory subsystem dazzled by being able to sustain a 2-2-2-2 timing to the unit's dynamic RAM, which was far faster than what the competition managed. Both the Deskpro and ProVEISA use a 128-bit

path to memory, but the Deskpro runs its memory at 66 MHz; this is comparable with the ProVEISA's 33-MHz memory design. ALR has focused its design efforts on a large and fast L2 cache. The combination of L1 and L2 cache minimizes the impact of a slower DRAM subsystem for most applications.

VIDEO

We limited DOS video test comparisons to desktop Pentium units, because servers rarely focus on video performance. The top DOS video speed of 6.15 million operations per second was logged by the Deskpro and its QVision subsystem.

The DOS video score was depressed for the DECpc, as expected for an S3 chip; it was a bit better for the Unisys Advantage Plus and its ATI Mach 32-based video. Both the DECpc and Unisys Advantage Plus use video chips targeted for graphical environments such as Windows.

DISK

Although we are not charting disk scores for the servers, we can report that the PS/2 Server 95 stole the show, with a score of 64.7 kilobytes per second using a 6,300-rpm Maxtor MXT-540S 540MB SCSI-2 disk drive and a proprietary SCSI-2 Fast/Wide Micro Channel disk controller. The Unisys Advantage Plus, with its 1.2GB Seagate ST1050-FX1 SCSI-2 drive and Adaptec 7770 Arrow controller, was tops in the desktop category, surpassed only by the PS/2 Server 95.

Most systems' disk performance triples when SmartDrive is utilized, a testament to the benefits of a large disk cache. The fact that many more disk

reads and writes occur to DRAM than to disk is quite evident, yet SmartDrive affects system performance in many expected and unexpected ways. With smaller files that fit in the cache, it speeds up all disk operations tremendously, but with larger files, it can either speed up or slow down operations.

DOSMARK

As always, systems with fast disk subsystems and fast processor/memory subsystems dominated our DOSmark scores. DOSmark scores tended to track with DOS disk results, with the exception of the Deskpro's showing; its higher memory and processor scores moved it ahead of the DECpc. The DOSmark scores measure a system's effectiveness at processing typical DOS applications. Based on typical DOS spreadsheet, word processing, graphics, and single-user database performance, they represent only a subset of the powerful CPU-intensive general-purpose and custom applications most likely to be used on Pentium systems.

GRAPHICS AND DISK WINMARKS

For the Graphics Winmark, the Unisys Advantage Plus, with its ATI Mach-32 video, topped the list of Windows systems, followed by the Deskpro, with its QVision video. For Windows use, we strongly recommend high-end video accelerators to avoid wasting CPU bandwidth on mundane video processing.

The Disk Winmark test suite focuses on an 8MB file model only, measures apparent disk speed as seen by the user, includes some Windows processing overhead, and does not necessarily track with the standard DOS-based disk tests, even when we are comparing 8MB models only. (The Disk Winmark tests allow both *apparent* and *actual* measures. Apparent measurements are taken when each test component is finished, as determined by the Winbench test program, but prior to SmartDrive's write-back cache being flushed to disk. Actual measurements wait for SmartDrive's cache to be flushed before time-stamping the result and firing off the next test component.)

Of the desktop systems, the Unisys Advantage Plus was again on top. The Deskpro placed second and the DECpc third, a reversal of their ranks in terms of DOS disk scores. The Deskpro's performance was boosted by its fast apparent random read and write operations.

WINDOWS APPLICATIONS

Our Windows applications test suite measures a system's ability to perform four Windows applications. The Ami Pro and Microsoft Excel tests emphasize processor and video speed. The CorelDRAW test focuses on processor, video, and disk performance, and the Superbase test is mostly disk-oriented. We report Windows applications scores for desktop systems only. Because the results are given in seconds, lower scores represent better performance.

The Unisys Advantage Plus outperformed the Deskpro and the DECpc, as it did on our Graphics and Disk Winmark tests. Its usage of the Intel 82486 L2 cache controller, which allows fast burst transfers from L2 to processor, was an important factor. The Deskpro and the DECpc were surprisingly close on all tests except for the Superbase test, where the Deskpro's faster disk operations under Windows stood out. We expected the Deskpro's 66-MHz processor operation and QVision graphics to outdistance the 60-MHz DECpc by a wider margin on the Excel and CorelDRAW tests, but this was not borne out.

The DECpc surprisingly outperformed the Deskpro on the Ami Pro test. It is possible that the Deskpro's write-through L2 cache and 2-2-2-2 burst read timing from L2 to processor were making processor-intensive operations a bit slower in some applications. The DECpc uses the Intel 82486 L2 controller with write-back capability, which bursts data at a 2-1-1-1 rate to the 60-MHz processor.

The Deskpro required 120 nanoseconds to perform a burst read transfer, while the DECpc required only 80 ns. If a larger-than-usual number of L2 cache reads are required during the aforementioned Windows applications

(that is, if there are more L1 cache misses than normal), the DECpc may appear better than expected.

SERVER THROUGHPUT TESTS

We compared all servers with 16MB of DRAM installed. On our tests with 32 clients each accessing a 256K file, the total file space accessed was only 8MB, allowing most disk accesses to be serviced from the NetWare cache. The 1MB-file tests forced many cache misses and required physical disk reads, reducing overall throughput.

The PS/2 Server 95, with its bulletquick drives and high-speed SCSI-2 controller, provided fast random-access operations on our 1MB-file tests, which stress physical disk hardware; it was even faster than the four-drive ProVEISA. When sequentially reading the common 512-byte blocks, the PS/2 Server 95 was very strong. This is attributable to its high-speed drive and fast CPU/memory subsystem.

The AcerFrame was comparatively slow at random operations but performed 512-byte-block sequential reads of 1MB files acceptably. When accessing its physical disks, however, the AcerFrame did not perform as well as might be expected for a four-drive system, although its performance on our random read/write tests was reasonably strong.

On the 1MB-file tests, the HP NetServer was second to the PS/2 Server 95 overall, with excellent sequential read and write results. Coupled with a fast disk subsystem, the HP NetServer's DRAM memory speed (the fastest among the tested servers) contributed to faster NetWare cache operations.

In general, the PS/2 Server 95's 66-MHz processor and LANStreamer Token-Ring adapters combined to provide high throughput. The ProVEISA's 66-MHz operation and its large and efficient 512K L2 cache improved the execution of NetWare operating system code and device drivers, allowing the unit to place second. Trailing behind the ProVEISA, the NetServer was no slouch, but its 60-MHz processor slowed its NetWare code execution.

How We Tested

WINDOWS WORKSTATIONS

We tested all desktop systems (the Deskpro, DECpc, and Unisys Advantage Plus) with our standard Hardware Benchmark Tests, Release 7.01; Windows Benchmark Tests (Winbench), Release 3.11; and a new Windows-based application test suite. This new suite ranks the desktop systems in terms of real-world application performance. The test suite uses Lotus Development Corp.'s Ami Pro, Version 3.0; CorelDRAW, Version 3.0; Microsoft Excel, Version 4.0; and Software Publishing Corp.'s Superbase, Version 2.0. Its operation was automated with either their own macro facilities or the Bridge Batch automation package from Softbridge.

SERVERS

We tested all servers (the AcerFrame, ProVEISA, NetServer, and PS/2 Server 95) with ZD Labs' NetBench, Version 4.0, with the goal of placing maximum stress on their file-serving capabilities. We performed multiple runs of our server throughput tests using popular file sizes (256K and 1MB) and read/write block sizes (512 bytes and 4K). Both sequential and random operations were performed. With 32 active 386DX/20-based workstations executing our tests against each server's file system, we were able to see sizable performance differences among the servers.

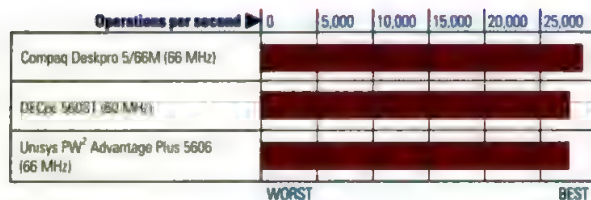
We installed 16MB of RAM into all servers for comparative testing, but we also ran the AcerFrame and the ProVEISA with 32MB of RAM to show the performance effects of a larger NetWare RAM-based disk cache. We asked each vendor to install at least two hard disks to help improve performance. We tested the AcerFrame with two 520MB drives; the ProVEISA had four 125MB drives, the NetServer had two 1GB drives, and the PS/2 Server 95 had two 540MB drives.

Except for the PS/2 Server 95, which used IBM's new and exceptionally fast 32-bit Micro Channel LANStreamer Token-Ring boards, each server was configured with four Madge 32-bit 16/4 EISA Ringnode Token-Ring adapters. We installed NetWare 3.11 on all servers and set up four network segments with eight clients on each. We then directed each segment to one of four equal-size disk volumes. NetWare was installed with 4K disk blocks and a maximum physical receive-packet size set at 4202.

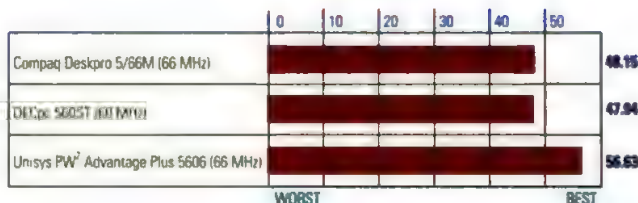
We tested the servers with 512-byte, 1K, 2K, and 4K request sizes, which mirror many popular network applications.

WINDOWS WORKSTATIONS

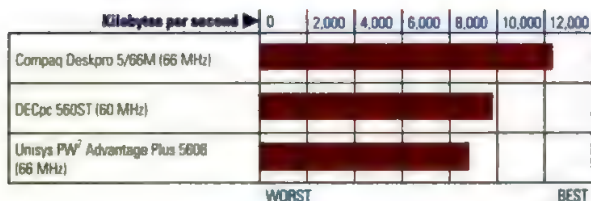
PROCESSOR



DOSMARK



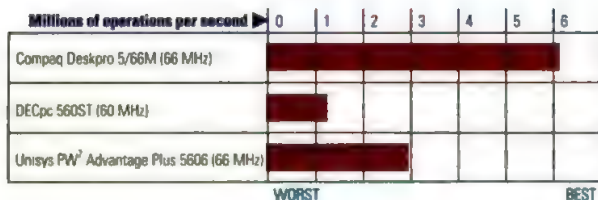
MEMORY



GRAPHICS WINMARK



VIDEO



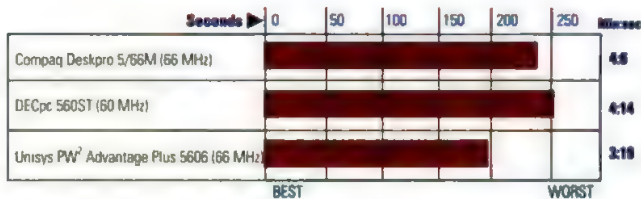
DISK WINMARK



DISK

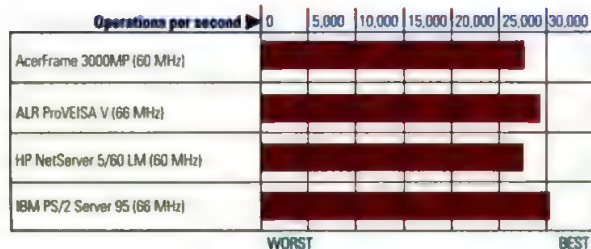


WINDOWS APPLICATIONS

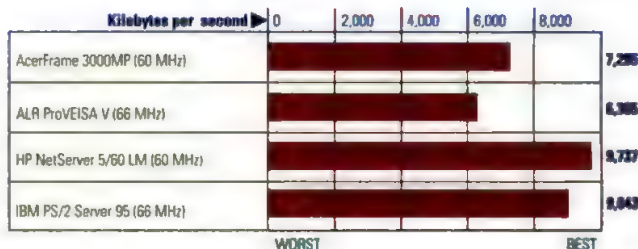


SERVERS

PROCESSOR



MEMORY



**RECENTLY,
SOME HAVE REFERRED
TO LOTUS 1-2-3
AS SOMETHING OF
A SLEEPING GIANT.**

LOTUS INTRODUCES 1-2-3 RELEASE 4 FOR WINDOWS.

THIS IS CLEARLY A TIME OF CHANGE FOR AMERICAN BUSINESSES.

To keep up with these changes, and the new ways of working they demand, business people need new and better-suited tools. Lotus® has responded by rethinking and re-creating the spreadsheet as a tool for individuals and for workgroups. 1-2-3 Release 4 incorporates over 4,000 spreadsheet user suggestions. It's dramatically easier to learn and use than any spreadsheet in history. It's much more powerful and productive. And it's the first spreadsheet that's actually designed to help people work together in impressive new ways.



sheet, it's a significant advance over Microsoft® Excel in usability.

THE FIRST CONTEXT-SENSITIVE USER INTERFACE.

Release 4 actually anticipates what tools and functions you'll need. Depending on what you're doing, 1-2-3 presents only the menu choices and **SmartIcon™** palettes appropriate to the operation at hand.

Since the features you need are always easy to find and remember, you won't spend time clicking

FEE. FI. F

IT'S MORE POWERFUL BUT VERY SIMPLE.

While adding dozens of major new features, hundreds of macros and hundreds of tools and @ functions, Lotus has actually simplified the way you work in a spreadsheet.

For example, Release 4 features an @ function pull-down menu to help you build spreadsheets faster. Cell copying is now a



The open-handed mouse pointer closes when you grab the cell.

simple drag-and-drop operation, with meaningful visual feedback.

through menus looking for them. They're where you want them when you need them.

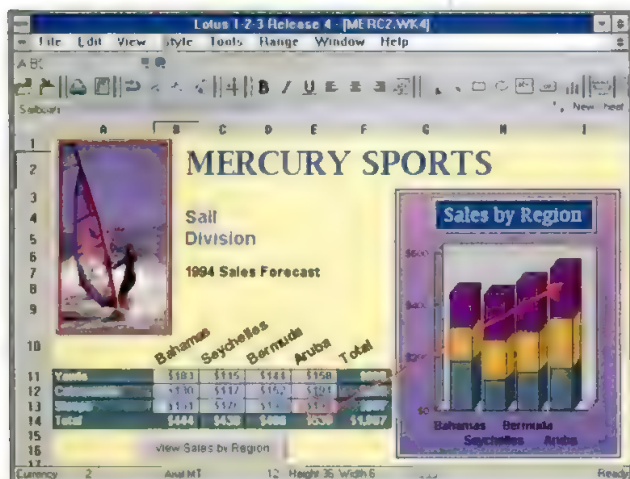
IMMEDIATE ON-SCREEN MANIPULATION.

A **Live Status Bar** on screen shows the attributes of any high-lighted element.



To make a change (like font, size or decimal points) you just click on the appropriate section of the status bar. Then scroll up to your chosen attribute and click again.

And unlike Excel, 1-2-3 R 4 includes **In-Cell™ Editing**, so you can



And changing text and font attributes is done in one dialog box. (Excel often requires three.) So 1-2-3® is not only a lot friendlier and easier to use than any other spread-

literally work *in* your spreadsheet. There's no need to go to the control panel. You can enter and edit any information right in the cell

And you can go directly to any named range on any page simply by clicking on the name in the exclusive **Navigator** menu.

ONE-STEP CHARTING.

With **One-Step Charting**, you can pick up all titles, data, legends and axis labels right from the

NAVIGATE THROUGH 3 DIMENSIONS.

Anyone who works on multiple worksheets will appreciate the new 1-2-3 **Worksheet Tabs** which can be labeled with real words. So you can go directly to any sheet simply by clicking on the appropriate tab.



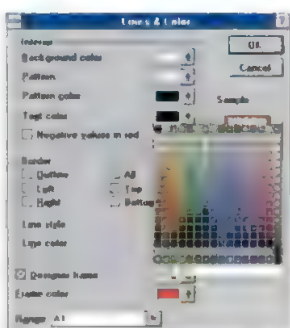
And Worksheet Tab names are then incorporated into formulas. All of which helps to keep 1-2-3's

For example, to modify or create a query, you don't generate criteria and output ranges with cryptic commands. Just bring up the Query Dialog Box and select the fields and records by name. Changing your query is as simple as drag-and-drop.

With DataLens® drivers for dBase IV®, SQL Server, Informix, OS/2® Data Manager, Paradox® and more (including ODBC support), 1-2-3 is the first spreadsheet that

O. FUM.

worksheet to create a great looking chart the first time, automatically. No need to launch into



some five step, semi-connected charting wizardry with its own

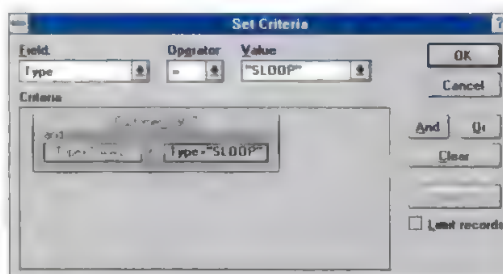
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set of commands just to edit a simple chart. And you can edit the chart right in your worksheet because all elements can easily be selected and manipulated directly. And you can even choose from 256 colors.

unique 3D technology simple and easy to use.

DATABASE FUNCTIONS MADE EASY.

The 1-2-3 database now has a new, completely graphical interface that makes using it significantly easier. Plus 1-2-3 provides a range of built-in tools that are powerful without being perplexing.



provides a completely integrated model for directly querying both on-sheet and external databases.

THE SMOOTHEST PATH FROM DOS TO WINDOWS.

If you're ready to make the move from DOS to Windows,™ 1-2-3 Release 4 is the way. It includes the traditional 1-2-3 ("") **Classic® Menu** as well as complete file, style and macro compatibility with your DOS version.

And if you're networked, just turn the page and you'll see why the best spreadsheet for you is the only spreadsheet for your workgroup.

THE FIRST SPREADSHEET FOR WORKGROUPS.

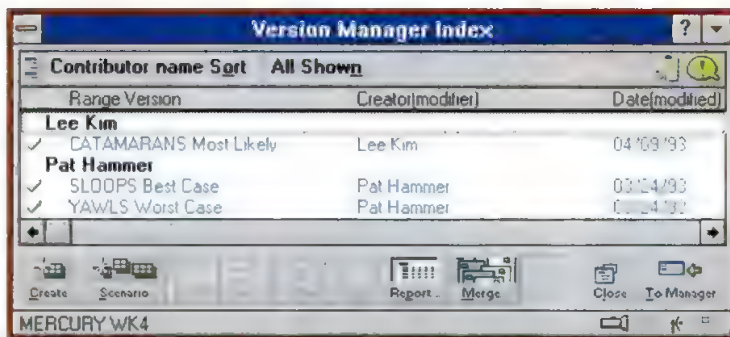


With 1-2-3 Release 4, Lotus transforms the spreadsheet into the powerful workgroup tool people have needed.

integrate
it into your
work?

You use
our inno-
vative
**Version
Manager,**

that's how. Version Manager tells you who did what when, and why they did it. It lets you save, label, track, mix, match, merge and comment on ranges, worksheets or entire files in



take on even greater proportions. Besides utilizing the impressive workgroup power of Notes, there are specific Release 4 features that synergize to offer significant

IT'S NOT JUST A NEW VE

Combining the analytical power of 1-2-3 with workgroup features, users can now share spreadsheet insights and information and collaborate in ways never before possible.

VERSION MANAGER MAKES WORKGROUPS MAKE SENSE.

Ever forgotten why you used a particular number? Or wanted to track more than one value in a cell or range? Or suppose you've sent a spreadsheet to a co-worker who develops a whole new version and sends it back. How do you

ways that make sense to you. And it does it all without overwriting existing data.

In fact, whenever a new version is created, 1-2-3 automatically "stamps" the version with the user's name and the date and time it was created.

1-2-3 MEETS LOTUS NOTES. TOGETHER, THEY CHANGE EVERYTHING.

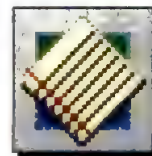
This is the way people ultimately want to work. Not just together. Concurrently.

If you have Lotus Notes®, the workgroup benefits of the new 1-2-3

business advantages. Here are just a few.

Now different users can access and work on the same spreadsheet at the same time. Notes maintains file integrity and notifies you of changes made by others. So you know you're using the right numbers.

Notes also features replication. This means that even if you're disconnected from the network while you travel, you can stay up-to-date and still participate fully in the spreadsheet sharing process



when you reconnect.

To maintain security and integrity, users can create access lists and grant varying privilege levels on a per-user basis.

And all this comes standard as part of the new 1-2-3 Release 4. No add-ons, customizations or new application development is necessary.

WORKING TOGETHER IN SUPPORT OF INDUSTRY STANDARDS.

1-2-3 R 4 supports object-linking

A FEW OF THE SPREADSHEET ENHANCEMENTS REQUESTED BY OUR USERS.

120 new @ functions (engineering, statistical, financial, calendar, informational, mathematical)
16 Designer Frames
256 color choices
64 fill pattern choices
250 new macro commands
Animated tutorial
AutoSave option
Center text over a range
Charting of 23 data points
Clean screen elements
Column, row and worksheet selection
Cross Tab
Customizable data fill
Define column aliases for database queries
Discontiguous range selection and charting

Pre-built dialog boxes for application development
Print range stored in print settings
Print to fit columns
Print to fit rows
Print to fit page
Print to fit chart
Print charts directly
QuickMenus
Context-sensitive right mouse-button menus
Reads XLS spreadsheet files
Rotate cell contents up to 90 degrees
(Send-SQL) macro command
Shared dictionaries (across Lotus apps.)
Shows file links in dialog box
SmartIcon bitmap editor
Spell checker
Style gallery containing predefined style templates
Text wrap in edit line
True on-sheet draw layer
Vertically centers text within a cell
Windows-common dialog boxes
Wraps multiline text in a cell
+ or = sign to start a

VISION. IT'S A NEW VISION.

and embedding technology for both clients and servers. This enables users to display data from a 1-2-3 spreadsheet into any OLE client application such as a word processor or presentation software. 1-2-3 also complies with VIM and MAPI standards so it works with cc:Mail™, Lotus Notes or any other VIM- or MAPI-compliant mail system installed on your computer. So you can send a worksheet, a range or an entire file as an e-mail message to another user.

All without ever having to leave 1-2-3.

Displays up to five most recently opened files
Easier computed columns and rows
Enhanced Help system
Enhanced macro transcript
Escape from Help
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Fill down, fill right
Floating, wrapping text boxes on sheet
Gradient fills
Group draw items
Help icon in dialog boxes
Icons in page setup
Interactive print preview
Justify labels and values left, right, center
Keyboard shortcuts
Long prompt text feedback in title bar
Lotus shared dialog box editor
Macro buttons on sheet
Named SmartIcon sets
New chart types
Numeric format WYSBYG dialog box
Numeric up/down "clicker" on number fields
Partial insert/delete of rows and columns
Post selection from all range controls

formula automatically
Converts to "@" formula
@ function arguments supplied
(A more detailed list available on request.)

THIS IS THE BIG ONE.

Lotus 1-2-3 Release 4 is here. Now. And because it's network ready, one box is all it takes to upgrade all your users, whether they're working off a server or their own PC.

Call 1-800-TRADE UP, ext. 8842,* for a free demo disk or to order your upgrade for just \$119 direct from Lotus. Or visit your Lotus Authorized Reseller.

Lotus

1-2-3 Release 4
SPREADSHEET FOR WINDOWS



edged world standard for electronic mail. Which explains why cc:Mail is used by 3 million people worldwide.

Lotus Organizer™ is rated best in the PIM category.

And Lotus Notes is the talk of the industry, redefining workgroup computing in practical ways that upgrade vital business processes.

All these Lotus Windows applications look, feel and work together

Freelance Graphics, cc:Mail, and Lotus Organizer, 1-2-3 Release 4 completes a suite of advanced Windows applications that's years ahead of any competition.

For a limited time you can upgrade to SmartSuite 2.0 from any Lotus or competitive product** and receive a \$50 rebate direct from Lotus. And remember you can upgrade to 1-2-3 Release 4 for just \$119, direct from

Lotus 1-2-3 Release 4 is joined by a full complement of the most power-

1-2-3 IS BACK. AND IT'S NOT ALONE.

ful, easiest-to-use business applications ever available to Windows users. That's not our claim, or an opinion. It's a statement borne out by users, reviewers and publishers every day.

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For the last two years, Lotus Freelance Graphics® has dominated both Harvard Graphics® and PowerPoint® for power as well as ease of use.

Lotus cc:Mail is the acknowl-

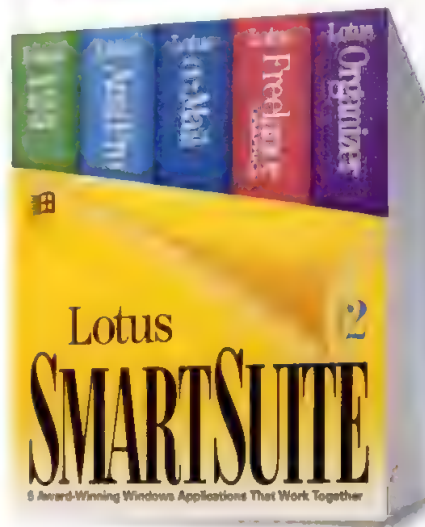
like they were made for each other. Because they were. With only one user interface to learn. Common SmartIcons that work across applications. Seamless transport of data and charts between applications. And one spell-check dictionary that works across these applications.

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Lotus 1-2-3 Release 4 SPREADSHEET FOR WINDOWS

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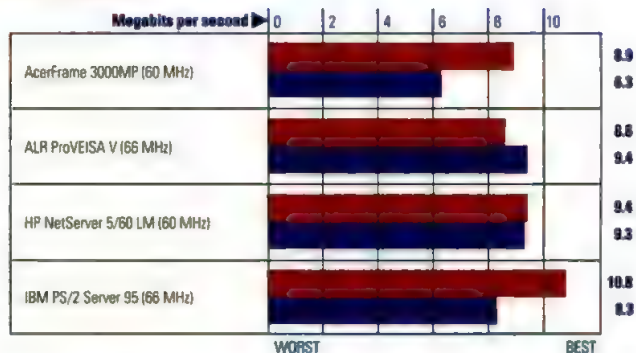
SERVERS

256K files

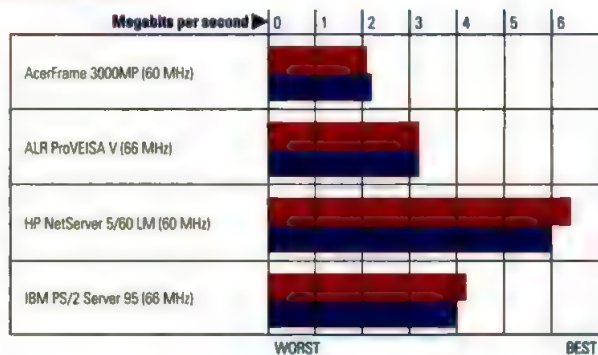
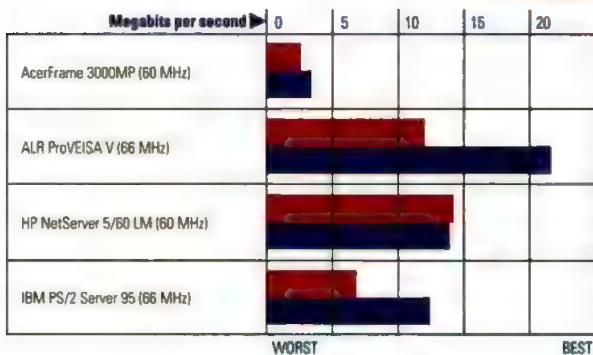
1MB files

■ 512-byte blocks ■ 4K blocks

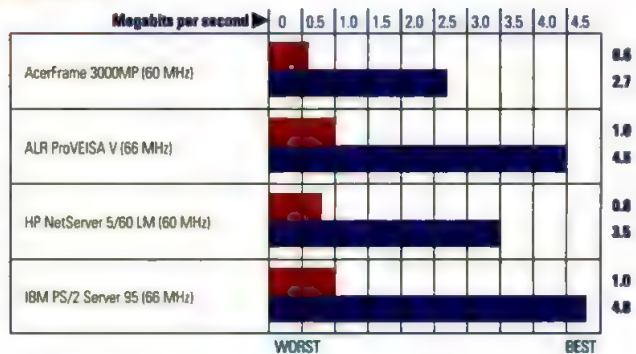
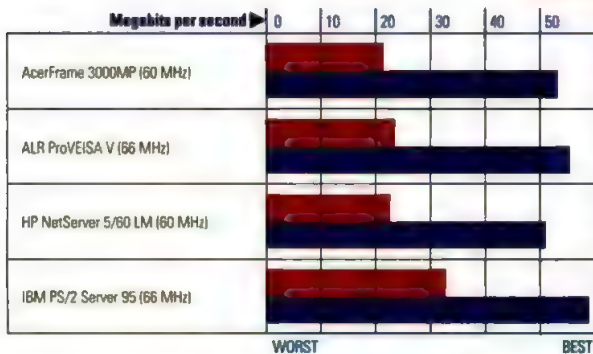
SEQUENTIAL READ



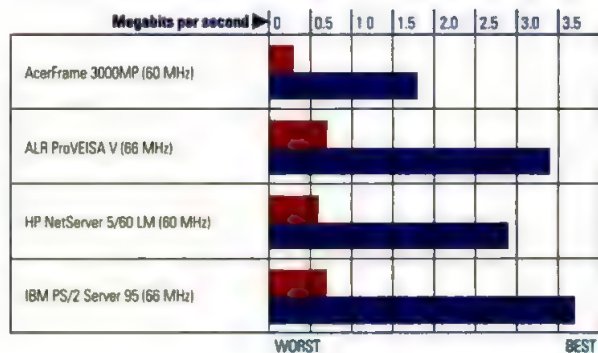
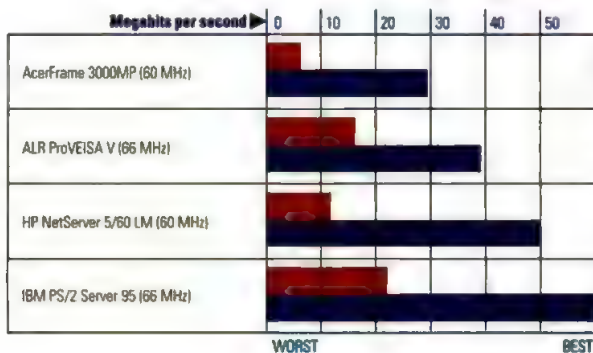
SEQUENTIAL WRITE



RANDOM READ



RANDOM READ/WRITE



put that into some sort of perspective, a micron is a millionth of a meter, or about $\frac{1}{15}$ the thickness of a human hair.) Combining miniaturization on that level with high-volume production can be quite a daunting task. And following an oft-quoted industry maxim on progress in chip design—that we're able to squeeze about twice as many transistors onto a chip every 18 months or so—Intel crams 3.1 million transistors onto the Pentium versus the 486's 1.2 million transistors.

Thus, 60-MHz Pentium chips are not a separate design, but simply those chips that didn't meet the company's tests for the rigors of 66-MHz operation. Intel is offering these not-quite-up-to-full-spec parts to Pentium-hungry vendors in order to address the severe Pentium shortage that it faces. Of course, the ulterior motive is to maximize revenues by selling as many chips that come off the line as possible.

60- OR 66-MHz

It's tempting to label these 60-MHz chips as below-par, marked-down goods to be avoided. After all, if you're paying the hefty price for these all-out systems, shouldn't you get every last ounce of speed you can? In practice, though, there's absolutely nothing wrong with the 60-MHz Pentiums. Moreover, we found surprising variations in overall system performance among systems with both chips. We found that the speed of the CPU counts at least as much as the PC system built around it.

The tests confirmed just how much the job of building a high-performance machine with the Pentium microprocessor is a true *systems*-design job. Granted, we saw the expected 10 percent advantage in raw processor speed the 66-MHz machines had over the 60-MHz machines. (The Small Mix portion of our processor benchmark test measures how quickly a CPU can process data that fits entirely inside the chip's 16K of internal Level One cache, so the 66-MHz parts *should* have been 10 percent faster.) But

when you look at overall system performance—the new applications suite testing we did on the workstations, for example—you'll find that the 60-MHz Unisys PW² Advantage Plus system beat the 66-MHz Compaq and Digital machines by a comfortable margin.

That unexpected outcome also underscores how early we are in the Pentium era and how steep the learning curve is for optimizing this chip. A predictable system-performance difference based on

CPU speeds can very easily be offset by other engineering gains and losses. Our advice: Ignore the difference between 60-MHz and 66-MHz Pentium chips, and make your buying decision on the overall

relative performance of these machines and on their features.

Understanding why there's a lot more to an optimized Pentium system than just the CPU requires understanding both how the several subsystems of a powerful PC interact and the relative importance of the performance of each subsystem in your application (see "Pentium: What to Look For"). The limits of the 486's computing ability, when the machines are used as servers and as standalone machines, aren't based on shortcomings of the CPU. Rather, slow I/O combined with small, slow caches and slow memory hold back performance. By contrast, a Pentium-based PC will suffer from those same limitations and bottlenecks, throwing away much of its potential. Although there are some tricks, this will continue until designers come up with better answers in those areas.

These machines show the manufacturers' serious effort at optimizing critical subsystems, and as more attention is paid to overall system design, we'll see even more improvement. Compaq's TriFlex PC architecture, with a fast, wide 64-bit CPU bus, an extremely wide 128-bit memory bus, and bus-arbitration logic, is a good example of the kind of advanced engineering that is required to make the most of the Pentium. It takes the general PC paradigm that designers have been

working within to new heights.

If designing a solid Pentium system is no easy job, building one apparently isn't so simple, either. We saw many jumpers and prototype and engineering-sample chips on motherboards, but we didn't expect to find poor cable routing, ill-fitting cases, expansion slots blocked by jury-rigged cooling gizmos, and the other examples of sloppy work that appeared in some of these machines. Check the individual reviews for details on what we found because we feel strongly that the care taken in the details is indicative of the engineering resources marshaled to bring these systems to market, and eventually in the general quality of the system.

BUYING DECISIONS

Increasingly, we've found the relative performance of groups of similarly configured very-high-end PCs to be rather similar. The use of more advanced systems-design techniques by some vendors has opened the gap between top- and bottom-drawer performance more than usual.

But there's more to buying and installing a high-end computer than raw performance. Beyond the numbers, it's important to look at how closely system designers matched their results to buyers' needs. For example, this class of computers is widely represented as ideal network servers, yet some machines that want to be king of the server hill are sadly ill-equipped for the role by virtue of their limited expandability. The DECpc 560ST, which will be sold as either a workstation or file server, for example, offers only five drive bays, only six EISA expansion slots, and a wimpy (by server standards) 256-watt power supply. Digital sells the ST line as networks for small servers, but we wouldn't be very comfortable with so limited a machine—especially in this high-power league—with so little expandability.

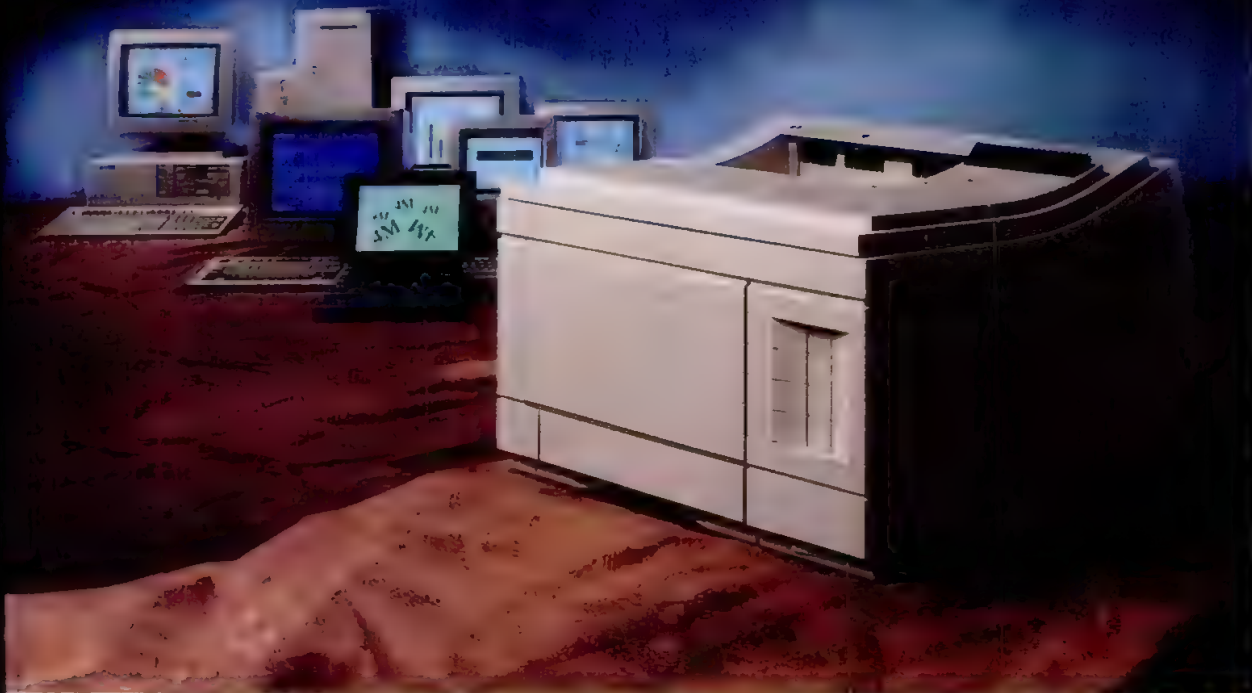
Some other machines, by contrast, had plenty of drive bays and expansion slots and sufficient power supplied for their intended role. The IBM and Hewlett-Packard cases, particularly, are well-suited to server roles.

Video performance is another interesting test of suitability to function. Most network managers don't worry about the

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Introducing the HP LaserJet 4M.

Now everyone can tap the power and performance of an HP LaserJet printer. The HP LaserJet 4M. A printer made with everything your PC and Mac users expect: built-in genuine PostScript™ Level 2 from Adobe™, 6 MB of standard memory, standard LocalTalk, optional EtherTalk, built-in Windows TrueType fonts, and

the best 600-dpi print quality available.

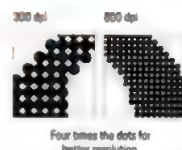
Greater flexibility for mixed environments.

Because it's designed to be shared simultaneously, the LaserJet 4M gives you greater flexibility for mixed environments without compromise to either. Automatic language

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Its wide range of typefaces, two integrated paper trays, and the options of a 500-sheet tray and a power envelope feeder set a new standard in versatility.

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The HP LaserJet 4M is the one for all. Macintosh and PC alike. This new generation provides superior output with 600 dpi. Resolution Enhancement technology and microfine toner. Built-in memory that PostScript Level 2 and full-page graphics print out crisp, clear and fast.

LaserJet

4M

4M 4M 4M 4M 4M

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■ Pentium: *What to Look For*

by Nick Stam

To fully exploit the Pentium's potential, Intel has placed a design burden on system vendors, encouraging high-performance I/O subsystems, fast memory, large caches, and advanced bus designs. While a system may include all these features, there's no guarantee they've been optimized. The following sections should provide insight into important system features that will help you get what you need from your Pentium-based machine.

COMPAQ CACHES IN

Aside from whether the Pentium processor is operating at 60 or 66 MHz, your most important performance consideration is memory-design efficiency. The PC's memory design includes the main DRAM subsystem and the optional external processor cache (also known as a Level 2 or L2 cache). The Pentium's internal processor cache (8K instruction, 8K data) is effective, but for best performance, an external processor cache is a necessity.

Some vendors of Pentium-based machines have incorporated a 128-bit memory bus to enhance the data flow from DRAM to processor. This helps, but it doesn't ensure that the DRAM subsystem will keep up with the increased throughput demands. The Compaq Deskpro 5/66M reads data 128 bits at a time into its three-way TriFlex/PC controller, which apporions data 64 bits at a time to the Pentium processor.

The Deskpro's fast page mode DRAM enables the TriFlex controller to maintain 256-bit burst-mode transfers (four back-to-back 64-bit transfers) from DRAM. This speed matches data bursts from the exter-

nal cache in most instances. Also, Compaq is one of the few early vendors of Pentium-based machines that runs its DRAM subsystem at 66 MHz. This lets the Pentium communicate directly with DRAM should the external cache not contain the needed data.

In its upcoming Evolution V server product, Advanced Logic Research also uses a 128-bit design to feed the external processor cache, which, in turn, communicates via burst-mode transfers over a 64-bit path to the CPU. In contrast with Compaq's system, unfortunately, the Evolution's main DRAM runs at 33 MHz—half the processor's speed. This makes the Evolution's performance heavily reliant on the speed and effectiveness of its cache design.

Vendors that run Pentium systems with a 128-bit DRAM subsystem but without an external cache, have a common theory: They figure that by the time the second 64 bits are passed to the CPU, the DRAM chips will have had enough time to recharge for the next 128-bit access. Though this is correct *some of the time*, whether it's right *most of the time* is still subject to debate.

The other half of an effective memory subsystem is writing, and the Pentium does require system support for burst writes. The Pentium reads data from external memory (whether cache or main DRAM) in 256-bit (32-byte) "lines." It also writes to memory in lines the same size and can in some cases actually burst-write an entire line to external memory if the memory system provides specific hardware support. In general, burst transfers reduce the number of clock cycles required to move a cache line's worth of data. A typical 256-bit burst-read cycle in Intel's Pentium system board might take two ticks of the system's clock crystal for the first 64 bits, followed by one cycle for each successive 64-bit transfer (a 2-1-1-1 sequence). Most often, high-speed burst rates only occur between the external cache and the CPU, but occasional cache misses will require the CPU or external cache to speak directly with system memory.

The result is that carefully designed memory subsystems, such as those in the Deskpro, can ease that burden. The Deskpro's memory design allows sustained 2-2-2-2 burst reads from both the

external cache and main DRAM (assuming a DRAM page hit). Though this 4-by-2 timing may seem slower than the 2-1-1-1 arrangement for burst reads on an Intel-made motherboard, it only includes the trip from CPU to external cache. When Intel's design encounters an external cache miss and has to access main memory, it will suffer performance penalties.

Intel estimates a cache miss rate of anywhere from 5 percent to 10 percent, depending on the application. Multitasking, multiuser, or certain network server operations may force a large

FIVE WAYS TO A BETTER PENTIUM DESIGN

Optimization adds up to top system performance.

1. **Be sure to include as much external cache as you can in order to reduce memory bottlenecks.**
2. **An EISA bus combined with a VESA local bus will speed up video.**
3. **Look for a 128-bit memory bus to speed processing.**
4. **Choose a system that supports efficient burst reads and writes.**
5. **Stick to true Pentium designs, not adapted 486s.**

number of external cache misses, but the Deskpro's optimized DRAM design should shine under such applications.

INTEL'S SOLUTION

Compaq has been planning its system designs in anticipation of the Pentium for a couple of years now, but that's not true for all vendors. In order to get Pentium-based products to market quickly, some vendors, such as Digital Equipment Corp. and Hewlett-Packard, have chosen Intel's 60-MHz OEM Pentium system board.

Surprisingly, Intel's design connects memory to the external cache over a 32-bit bus, and its system DRAM runs at only half the processor speed (33 MHz in the case of a 66-MHz Pentium). Systems with DRAM less than the CPU speed will suffer a significant performance disadvantage when compared with units with faster DRAM designs, but Intel's fast 2-1-1-1 burst transfer cycles from the CPU to the external cache and high external cache hit rates will compensate for a large portion of DRAM-access penalties in many applications.

Many external-cache designs provide both write-back and write-through capability. Basically, a write-back cache will hold new information internally until it needs to flush the data. This gives the processor immediate control of the system. A write-through cache moves newly written information to the next level of memory.

The result is that a write-through cache can cause performance decreases when compared with a write-back cache. A write-back cache reduces memory-bus traffic (useful in multiprocessor systems), and it also allows long sequences of faster writes from the processor, since it doesn't immediately propagate them to DRAM.

Beware of current 486 systems that claim support for the as-yet-unreleased P24T OverDrive chip; it may support neither the write-back feature of the Pentium's internal cache nor the burst-write transfers.

ASSOCIATIVITY

External-cache associativity is also an important indicator of success with Pentium processors. Cache associativity refers to the manner in which the cache communicates with main DRAM. In a direct-mapped design, if the cache is, say, 256K in size, main memory is logically divided into 256K segments that can each map to the 256K cache. Within these, each memory location (or line) corresponds directly with a sibling line in the cache (that is, it can only be stored in that particular line).

If you have system memory of 16MB, you've got about 64 memory lines competing for the same line in the 256K cache. If your application asks for information from two different segments, and each competes for the same line, you end up thrashing the cache and actually performing two accesses to main memory or more—a significant slowdown.

In a two-way set-associative design, each line in main DRAM can be stored in two different locations in the cache. That way, a backup address can be used if the other one is occupied. A four-way set-associative cache merely ups the amount of alternate addresses.

I/O SUBSYSTEMS

Today's Pentium-based systems will provide advanced I/O buses such as Micro Channel and EISA. Sometime this fall, expect to see new systems based on the PCI (Peripheral Component Interconnect) local-bus specification. (For more information on PCI architecture, see the sidebar "PCI: A New Foundation.")

A disk cache is a must for Pentium-based systems. Either install additional system RAM for a software disk cache or get a caching disk controller. We strongly recommend a large software disk cache so that most disk reads and writes can operate at CPU memory speed.

By making the right choices regarding hardware components and how they fit together, you can end up with the most optimized Pentium-based system. □

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Non-Operating Shock	150 G's
Dimensions	148mm x 75mm x 28mm
Weight	350 gms

manufacturer

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Singapore 0511
Tel: (65)- 4727885 Fax: (65)- 4728040
Telex: RS 38155 KITIAN

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Canada L3R 1E4
Tel: (416)-4150145 Fax: (416)-4759840

KT Technology Europe B.V.
Hastelweg 268, 5652 CN Eindhoven, The Netherlands
Tel: 31 40 571555 Fax: 31 40 572077

video performance or specifications on servers, since their displays are typically used only for network-monitoring tasks. Accordingly, server video performance isn't critical. But for workstations, video capability has become one of the defining elements with PC Magazine Labs' Graphic Winmark becoming the lingua franca of performance. And since Pentium workstations are likely to be used in graphical applications such as CAD and desktop publishing, Windows video performance is especially important.

Among the three workstations we tested, the Unisys PW² Advantage Plus 5606, which uses the ATI Mach 32 video card, was at the top of our ranking, with a 17.7 million Winmark rating. While that is not the fastest video score we've seen so far, it is very respectable. Unisys was

followed closely by the Compaq Deskpro 5/66M, which uses Compaq's QVision video card, scoring just under 15 million Winmarks. (By summer, Compaq says it

*The 60-MHz Unisys PW²
Advantage Plus 5606 beat
the 66-MHz Compaq and
DEC machines by a
comfortable margin.*

will upgrade the QVision to handle resolutions up to 1,280-by-1,024.) The DECpc 560ST, with its S3-based Cardinal video display, lagged a little with a

score of about 8 million Winmarks.

A feature that will prove important and useful across the board in these machines is the use of Flash BIOS systems. With these early Pentium designs, BIOS updates are likely and encouraged. A Flash BIOS lets users update their BIOS by running an upgrade floppy disk provided by the vendor. Five of the seven machines tested used Flash BIOS.

Look, too, across the board for effective cooling. The Pentium chip can easily reach surface temperatures of 160 degrees and more. Even worse, the kind of high-end systems that are built around Pentiums are likely to be packed full of heat-generating RAM and big hard disks. Hot chips don't just self-destruct; they can and often do take with them surrounding components and motherboard

■ NCR's Multiple-CPU PCs

by Brian Nadel

If you thought that a Pentium processor on or around your desk was the ticket to the personal computing big time, how about a pair of these powerful CPUs working together? For that matter, how about 16 Pentium processors churning through data? NCR Corp., a subsidiary of AT&T Corp., has designed a series of computers that can handle up to 16 CPUs arranged in a tightly bound, symmetrical multiprocessing system.

Members of NCR's System 3000 family range from the 3360, a single- or dual-Pentium system, to the 3555, which can take up to 16 CPUs. These high-end systems, which use IBM's proprietary Micro Channel architecture bus, are aimed at users who use engineering workstations or mainframe computers. Together, the 3360 and 3555 are more than mere PCs and define the outer boundaries of Pentium performance.

The 3360 tower system, which starts at \$26,000, was designed for server and high-end graphics applications that demand the fastest CPUs available. The system uses either 486- or Pentium-

based microprocessors, and it supports up to 6.3GB of internal data storage, as well as an abundant 512MB of system memory. The unit we looked at was driven by a 66-MHz Pentium, but we found you can double up CPUs, al-



lowing the system to break the 200 MIPS (million instructions per second) barrier. Single-Pentium machines are rated at roughly 112 MIPS, and a 486DX2/66 is rated at 54 MIPS.

The NCR 3555 stands as the King Kong of PCs. As high as your shoulder and broad as a bookcase, it's not only

physically imposing; it's a computing powerhouse as well. With 56 internal drive bays capable of holding up to 112GB of internal data storage, there is no shortage of expansion space for even large database systems. The 3555 system is aimed at transactional processing applications and can support up to 10 SCSI channels that are capable of transferring data at the rate of 10MB per second.

System memory should not be a constraint either, because the 3555 can be configured with 1GB of RAM (a 2GB upgrade will be available by summer). Fully loaded with 16 Pentium processors, the 3555 can perform 1,440 MIPS; it's a system that was designed with Intel's next-generation microprocessors in mind.

Rob DiGiacomo, a senior product manager at NCR's midrange computer division, said that prices for the 3555 start at about \$100,000. Prospective buyers, he said, are looking for a replacement for their mainframe that is both cheaper and has lower operating costs. "It's not what you'd plug into your cubicle to do word processing," he added. □

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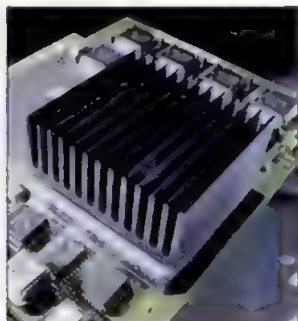
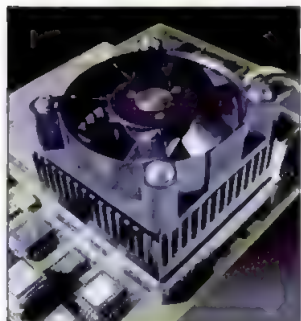
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traces when they turn into toast.

With Pentium-class processors, system cooling is critical. Bizarrely, we've reached the point in PC design where mechanical engineering skills and innovation are becoming almost as important as electrical engineering savvy. A combination of heat sinks, multiple cooling fans, and well-designed airflow patterns



To deal with overheating and possible chip burnout, caused in part by the Pentium's many transistors and monstrous appetite for electricity, vendors are utilizing chip-mounted fans (left) and heat sinks (right).

are necessary to keep these boxes from turning into high-tech Fryolators.

PATHS TO POWER

If none of these systems seem quite powerful enough for you, your need for power is indeed impressive. There are several alternatives: Wait a few months to see if those second and third waves of Pentium PCs we foresee materialize on schedule. By one system designer's guess, machines designed from the ground up as Pentium PCs may be able to deliver twice the performance improvement over 486s that we see in these seven PCs.

Or wait until the next generation of Intel processors appears. That will be the P6, now in concurrent development with the next-generation P7 (see "P6 and Beyond"). Current guesses are that the first P6 machines will appear sometime in late 1994.

For those determined to live on the computing cutting edge, another option is a multiprocessor powerhouse by choosing a machine such as the AcerFrame 3000MP reviewed here, which accepts up to four Pentium CPUs, or other designs, such as AST's Manhattan, which accepts up to 16 Pentium CPUs. Or, depending on your cash position and the depth of your lust for power, maybe even an NCR 3555, which not only drives 16 Pentium

CPUs but also will accept up to 2GB of RAM and has 56 internal drive bays (see "NCR's Multiple-CPU PCs"). Expect to pay well into the six digits for that kind of power. Just make sure you have an operating system that can use symmetrical multiprocessing and all that memory and storage space. Windows NT is a likely bet for the power-mad, but early versions "out of the box" will handle two CPUs.

Finally, if you're not wedded to the Intel x86 architecture, machines that are based on other new high-performance CPUs, such as Digital's Alpha-series chips and the Silicon Graphics R4000, may appeal to you. With Microsoft's promise to port Windows NT to these platforms, you may—for the

first time—be able to take along your current applications to a new, non-Intel home. Most business PC users are likely to feel more comfortable—and entirely satisfied—within the familiar x86 universe.

The first seven Pentium systems are out in front of the PC world in terms of cost, as well. Most hold the line below \$10,000, but the IBM PS/2 Server 95, with its expensive Micro Channel bus architecture, and the multiprocessor-capable AcerFrame 3000MP will likely lead the pack in price tag.

If none of these costly choices seems likely, what about upgrading your existing 486DX2 PC? Some vendors will soon be releasing plug-in processor-upgrade cards for their existing 486 designs. Because of memory and I/O bottlenecks on those 486 motherboards, you won't get the performance we have seen on these first seven reviewed Pentium PCs, but you should get a performance improvement of 30 to 50 percent over those 486's numbers. Later this year, we will also see motherboard-level upgrades for some 486s, which should come nearer—but not necessarily equal—the scores in these reviews.

Another approach is to swap the present CPU for a Pentium OverDrive processor. Intel is too busy this year cranking out full-bore Pentiums to worry about the aftermarket buyers. But if you have a 238-pin CPU socket on your system—one with the extra rows of pins that a Pentium requires—then watch next year for what is now called the P24T chip. It should plug into your current PC and provide a substantial power boost (see "Upgrades: Easier Than You Think").

How substantial? That's impossible to tell now, but the evolution of the Pentium line may help here. Some experts believe that when Intel starts making Pentium OverDrives in a year or so, it will have boosted the clock rate of most Pentium chips to 100 MHz or so. Though a 486 design upgraded with such a fast chip would still suffer from the memory, cache, and I/O problems that beset any 486 PC running a Pentium processor, the raw CPU speed of such a chip could produce a very cost-effective machine.

For now, that's all conjecture. If you want more power than today's best 486DX2/66 PCs offer, your answer today probably lies among the machines reviewed here. In the brave new 100-plus-MIPs world of the Pentium, these are all fast, powerful computers. We'd swap our current 386s and 486s for any one of them in a moment. Maybe you should too.

Because the Pentium really is going to—in fact, already has begun to—change the PC business.

Acer America Corp.

AcerFrame 3000MP

The AcerFrame 3000MP is an extremely well designed high-end server with peripheral and system-card expansion provisions unmatched by the other reviewed systems. One of the two systems here that can handle multiple Pentium processors, the AcerFrame is a cut above the rest.

The AcerFrame's sturdy case is mounted on casters and has heavy, clip-mounted, easy-access metal covers. The

Acer AcerFrame 3000MP	
SUITABILITY TO TASK	
Scalability	EXCELLENT
Security/fault tolerance	GOOD
Throughput/small block	FAIR
Throughput/large block	GOOD

COMPUTERS

Pentium PCs

motherboard and expansion cards are on one side of the case, and an eight-bay vertical-drive stack and a prodigious 500-watt power supply are on the other.

There are four fans, two on each side. The 60-MHz Pentium chip doesn't have its own fan but is covered by a thick aluminum heat sink plate, which also covers the cache controller and standard 256K RAM cache. To protect the system from accidental power cuts, both the AC cord socket and the power switch are recessed in the bottom rear of the machine. Expansion cards are mounted with their cable ports pointed up, expansion-card connectors are protected by the case, and wires are kept neat with cable guides.

There are 16 card connectors: 6 proprietary 64-bit FrameBus slots, 8 32-bit EISA slots, and 2 ISA slots (which form part of two FrameBus slots). Because of the position of ISA slots, only 14 cards can be installed at once.



FACT FILE

AcerFrame 3000MP

Acer America Corp., 2641 Orchard Pkwy.,
San Jose, CA 95134; 800-733-2237,
408-432-6200; fax, 408-456-0471

Estimated list price (tested configuration):

\$25,000

Memory and processor RAM cache: 32MB 80-ns proprietary modules, 256K external cache.

Disk drives and controller: Two Fujitsu M2624FA 12-ms 520MB SCSI-2 hard disks with 256K cache, UltraStor 24F EISA card disk controller with 64K cache, 1.2MB floppy disk drive

Display: Acer proprietary ISA card video controller with 1MB of VRAM, Acer AcerView 25LR 14-inch monitor with 72-Hz refresh rate at 1,024 by 768

Software: DOS 5.0

In short: This is an impressively designed, capacious server that can hold up to four Pentium module cards

ON READER SERVICE CARD

The six FrameBus slots are used for CPU modules or memory cards: Two are used for CPU cards, and the other four can be used for memory. Each memory card can take four 16MB memory modules for a maximum of 64MB per card.

The CPU card can be upgraded to handle two Pentiums via a plug-in daughtercard. But because of the size of the daughtercard, a memory slot is blocked per dual-Pentium CPU card installed. Memory is thus limited to 128MB with four Pentiums installed (since only two memory slots remain unblocked) and 192MB with three Pentiums installed. New 128MB memory cards are planned for later this year. The first units offered will support only one or two Pentiums. Three- and four-Pentium units are reportedly under development.

Pentium CPU-card prices weren't available at press time (a 486DX/50 CPU card with CPU and cache installed lists for \$3,995). Unpopulated memory cards cost \$595, and 16MB memory modules list for \$1,595.

The tested system—with 32MB of RAM, an UltraStor 24F controller, two Fujitsu 520MB EISA SCSI-2 hard disks, and a proprietary nonaccelerated video setup—was not a hot performer on PC Magazine Labs' DOS benchmark tests, but held its own on most of our network benchmark tests.—Bruce Brown

Advanced Logic Research Inc.

ALR ProVEISA V

In recent months, the ALR ProVEISA has made frequent appearances in *PC Magazine*. In May, it was featured in an article on 486-based servers. It then turned up in a June First Looks piece on Pentium prototype machines. Across a wide range of file and block sizes, the ProVEISA V performed well.

Inside the ProVEISA V, you'll find a 300-watt power supply with plenty of connectors and 12 drive bays. Only 6 bays are in a 5.25-inch form factor (the only size in which you can easily get a 1GB SCSI drive right now), but this should be enough for most users.



FACT FILE

ALR ProVEISA V

Advanced Logic Research Inc., 9401
Jerónimo, Irvine, CA 92718; 800-444-4257,
714-581-6770; fax, 714-581-9240

Estimated list price (tested configuration): \$6,500

Memory and processor RAM cache: 32MB 70-ns SIMMs with 512K external cache

Disk drives and controller: Four Western Digital Caviar 2120 15-ms 120MB IDE hard disks with 64K cache, ALR Multus integrated disk controller, 1.44MB floppy disk drive.

Display: ATI UltraPro EISA card video controller with 2MB of VRAM, ALR Hyper VGA 14-inch monitor with 72-Hz refresh rate at 800 by 600

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The ALR ProVEISA V offers good hardware and excellent video, but the use of IDE hard drives led to bottom-level disk scores on our benchmark tests

ON READER SERVICE CARD

The Pentium chip is cooled by three fans: one in the power supply, another in the front of the case near the processor, and the third on the lower part of the chassis. The second fan is equipped with a thermal sensor.

ALR's modular motherboard is of a proprietary design and can take different CPU modules. The motherboard chip set

is a joint ALR and Intel effort, while discrete logic manages the 512K, direct-mapped, write-back external processor cache.

The ProVEISA can hold 256MB of RAM on the motherboard. Strangely, even though ALR positioned the ProVEISA as a server product, the company configured the test unit with four 120MB Western Digital Caviar 2120 IDE hard disks. The IDE drives hurt the unit during competi-

ALR ProVEISA V

SUITABILITY TO TASK

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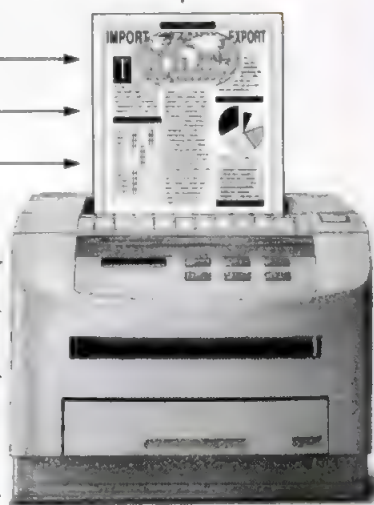
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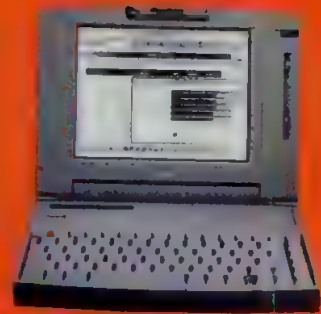
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■ PCI: *A New Foundation*

by Tin Albano

PCI (Peripheral Component Interconnect) architecture, one of the most talked about technologies of the year, is about to become a reality. Though Intel has pushed this technology and will likely have the first chip set on the market, other vendors will follow with their own implementations.

With the introduction of Intel's 82430 PCIsset chip set, vendors can begin developing systems that fully exploit the processing performance of the Pentium CPU without making major changes to existing PC architecture. PCI architecture is designed to work in concert with current ISA or EISA buses.

PCI puts the video graphics chip, LAN I/O, SCSI, and basic I/O components onto a separate bus. In today's PCs, these components are located on the ISA, EISA, or MCA (Micro Channel architecture) buses. With PCI architecture, these components can oper-

ate on a 32-bit bus at 33 MHz. The ISA bus is only 16 bits wide and runs at a mere 8 MHz. Although the EISA and MCA standards use 32-bit buses, they can only operate at 8 MHz and 10 MHz, respectively.

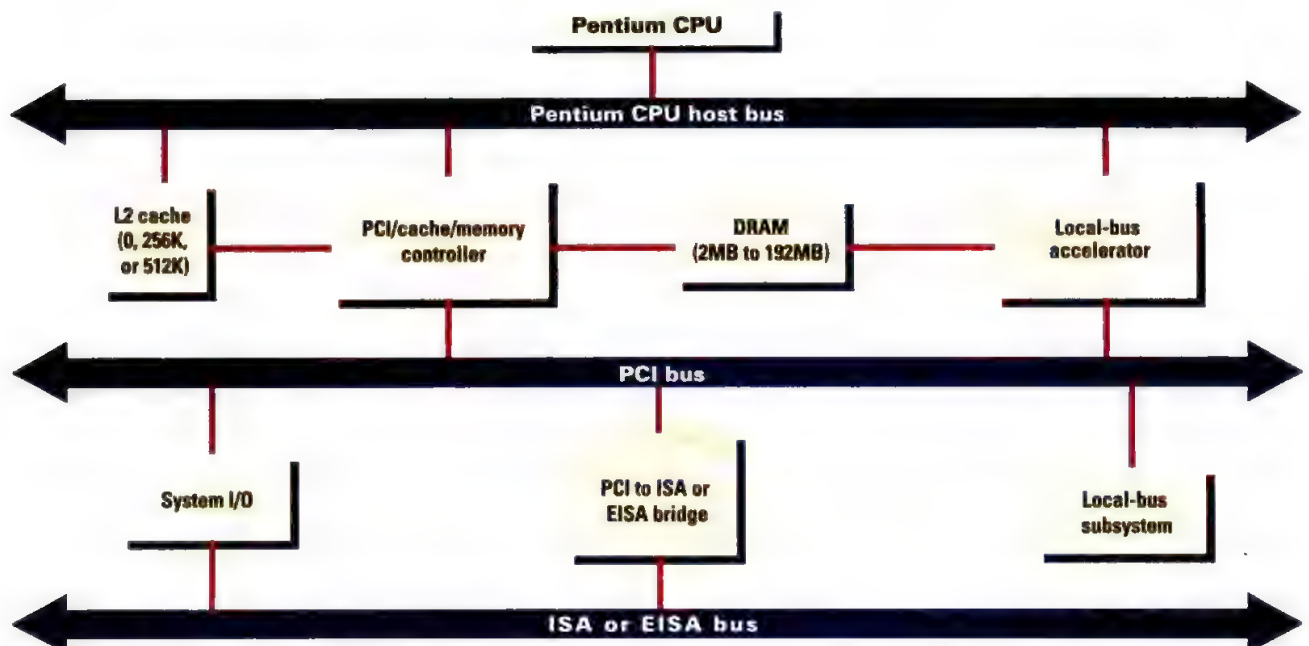
The 82430 PCIsset consists of Intel's 82434LX PCMC (PCI/Cache/Memory Controller) and 82433LX LBA (Local-Bus Accelerator), and either a PCI/ISA or PCI/EISA bridge to connect to the main bus. The advantages of PCI are most apparent when it is contrasted with the VESA VL-Bus specification.

While both VL-Bus and PCI are nearly identical in terms of data throughput (130MB and 132MB per second, respectively), VL-Bus needs an additional bus controller for non-video devices and is limited to three peripherals at 33 MHz. At speeds above 33 MHz, wait states must be introduced to slow down components, or the number of peripherals attached to the local bus must be limited to two.

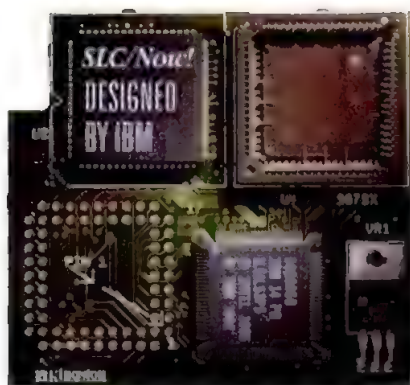
Bus-mastering cards tie up a VL-Bus system's local bus and don't allow the CPU and bus-mastering card to work concurrently. The VL-Bus architecture doesn't support the CPU's full burst mode either. PCI architecture allows up to 10 peripherals to work on the PCI bus at 33 MHz, and the PCI controller can use either a 32-bit or 64-bit data path to the CPU, which can run concurrently with multiple bus-mastering peripherals. The 82430 PCIsset supports 512K of external cache with burst static RAM.

PCI lets computer manufacturers integrate not only video but also other peripheral devices, such as LAN and SCSI devices, directly onto the local bus. While VL-Bus may be the quick and easy way for PCs to speed up graphics these days, PCI architecture has the potential to one day become the standard for systems running multiple peripherals at peak CPU performance. □

PCI: Peripheral Superhighway



PCI presents a three-tiered approach, giving peripherals direct access to the CPU.



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Landmark Speed 2.0:	8 MHz	35 MHz	22 MHz	286-based systems from AST, Compaq, Epcos, Everex, Hewlett-Packard, IBM, NEC, Toshiba and Zenith
Recount:	5:44 Min.	1:51 Min.	1:54 Min.	
Retail Price:		\$215	\$1,545	
SLC/Now!	PS/2 Model 90	With SLC/Now! 90	PS/2 Model 90-019	SLC/Now!
Landmark Speed 2.0:	13 MHz	114 MHz	84 MHz	IBM PS/2 Models 50, 502 and 60
Recount:	3:34 Min.	:29 Sec.	:38 Sec.	
Retail Price:		\$425	\$3,280	
486/Now!	PS/2 Model 70-200Hz	With 486/Now! SX 25	PS/2 Model 90-019	486/Now!
Landmark Speed 2.0:	39 MHz	84 MHz	84 MHz	IBM PS/2 Models 70 and 80, Compaq Deskpro Models 385, 385/20, 385/20e, 385/25, 385/25e, 385/33
Recount:	:55 Sec.	:39 Sec.	:38 Sec.	
Retail Price:		\$495	\$3,280	
MCMaster	PS/2 Model 755X	With MCMaster SX 25	PS/2 Model 90-019	MCMaster
Landmark Speed 2.0:	16 MHz	84 MHz	84 MHz	IBM PS/2 Models 55, 56, 57, 65, 70, 80 and 90
Recount:	2:47 Min.	:36 Sec.	:38 Sec.	
Retail Price:		\$795	\$3,280	

All systems tested with 16MB installed except MCMaster tested with 640K on-board and 1MB on mother board. All system prices are MSRP at standard configuration as of 4/1/93. Recount conducted on SAM Excel for Windows spreadsheet generated by Kingston Technology.



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CIRCLE 088 ON READER SERVICE CARD

tion with SCSI-2 devices in this roundup. Refer to our previous server story (May 11, 1993) for a look at the performance of a 486-based ProVEISA with two Maxtor SCSI hard disks and an UltraStor 124F controller. Six of the ProVEISA's eight EISA slots have bus-mastering capability, and I/O, video, and the IDE drive controller are integrated onto the motherboard.

ALR has included an ATI Ultra Pro EISA video adapter with 2MB of video RAM. Though we consider this overkill for a server, the ATI card did ensure great Windows video scores.

Under PC Labs' DOS benchmark tests, the ProVEISA performed mostly below average. The ATI Mach 32 graphics chip, which excels in Windows operations, was of little help. The ProVEISA's memory implementation was below average as well, probably because it was running main dynamic RAM at only half the processor speed.

Under Windows, things brightened considerably, with the ProVEISA placing second on our graphics tests. (For test results reflecting the performance of the ProVEISA's on-board VGA circuitry, see the aforementioned server review.) Disk scores, not surprisingly, ranked last, due to the IDE drive. Network test scores were competitive, particularly those based on large block-size format.

The ProVEISA ships with a five-year parts and 15-month peripherals and labor warranty. There's a \$9.95 charge for the first year of on-site service.—*Oliver Rist*

Compaq Computer Corp.

Compaq Deskpro 5/66M

Compaq's entry, the 66-MHz Compaq Deskpro 5/66M, has all the makings of a very hot Windows workstation. Enclosed in the venerable Compaq M series case and set up with 32MB of RAM, a 2MB QVision 1280/E video card, and a Conner 510MB IDE hard disk, the Deskpro performed well under both DOS and Windows.

The Deskpro's case reveals its intended use as a single-user system. With four



FACT FILE

Compaq Deskpro 5/66M

Compaq Computer Corp., P.O. Box 692000,
Houston, TX 77269-2000;
800-345-1518, 713-370-0670

Estimated list price (tested configuration): \$9,500.

Memory and processor RAM cache: 32MB 70-ns
SIMMs with 256K external cache

Disk drives and controller: Conner CP3051 12-ms
510MB IDE hard disk, integrated disk controller,
1 44MB floppy disk drive

Display: Compaq QVision 1280/E EISA card video con-
troller with 2MB of DRAM, Compaq QVision 200 20-
inch monitor with 76-Hz refresh rate at 1,280 by 1,024

Software: DOS 6.0, Microsoft Windows 3.1, Microsoft
Windows Sound System.

In short: With its fast performance on both DOS and
Windows tests, the Compaq Deskpro 5/66M is out-
standing as a high-end single-user system

 ON-READER SERVICE CARD

drive bays and five 32-bit EISA expansion slots, the Deskpro doesn't have the internal capacity needed for use as a file server. Most functions and features, including Compaq's Business Audio sound system, are integrated onto the unit's system cards. The only expansion card installed was the QVision video board.

The 66-MHz CPU is the brains of the system, but the company has done much more than just plug the processor into a socket. Using Compaq's own support chip set and an internal architecture called TriFlex/PC, the system maximizes Pentium performance with a 128-bit path from the TriFlex three-way controller to system memory and with two 64-bit paths from the TriFlex three-way controller to the CPU

and secondary cache. The TriFlex architecture also supports an efficient burst read/write setup.

The Deskpro's excellent CPU implementation showed up best in its scores on our memory tests, where it left the other systems far behind. As one of only two tested systems with an IDE drive (except for the Deskpro and the ALR ProVEISA V, the rest had faster SCSI-2 hard disk drives), the Deskpro turned in fairly slow disk scores, however, especially with Windows' SmartDrive software caching disabled.

But with the RAM disk caching in place, the Deskpro's system design overcame a slow hard disk drive and kept both Windows and DOS performance respectable, if not high. On our Windows Application test suite, the Deskpro turned in middling results. Its speed was neither exceptionally fast nor slow.

If you want fast video under both DOS and Windows, the Deskpro is the best choice here. Under DOS video testing, it walked away from the other desktop systems; it was more than twice as fast as the Unisys unit and almost five times as fast as the Digital unit.

The QVision card helped the Compaq to second place among desktops on our Graphics Winmark test suite. Its score of 14.92 megapixels per second compared with the Unisys unit's score of 17.68 megapixels per second.

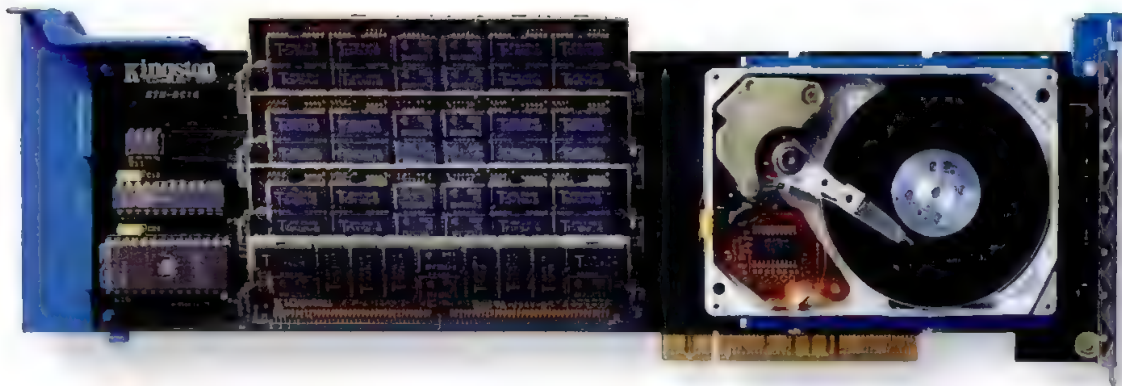
The first Compaq Pentium model benefits from the company's close work with Intel to maximize performance. If your applications demand the fastest available single-user computer, stand in line for the Deskpro 5/66M.—*BB*

Digital Equipment Corp.

DECpc 560ST

Digital's DECpc 560ST is a system that could do double duty as a server or workstation. The unit we tested is best suited as a high-performance single-user machine. With its Intel Xpress architecture-based motherboard and 60-MHz Pentium processor, the 560ST was a solid midrange performer in this field of very fast systems.

Digital sells the ST line as high-end workstations or full network servers. But



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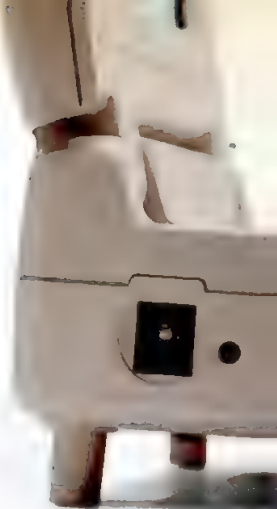
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■ Upgrades: *Easier than You Think*

by Christopher Barr

By now you're no doubt convinced that you want the power of a Pentium-based machine, but since your current 486-based PC is practically brand new, you face the dilemma of everyone who wants to harness the latest and greatest micro-processor.

The market offers several alternatives at various levels of performance and ease of installation. To avoid the pitfalls of being saddled with the wrong equipment or, worse, with a PC that will be outmoded long before its time, you must carefully weigh each alternative.

The best strategy for moving to a Pentium-class PC is to buy a Pentium system. Since the chip has a 64-bit-wide data bus, only a system that was designed for a Pentium CPU will really exploit its power. The Pentium chip has a dual-integer pipeline, two on-board caches, and a redesigned floating-point unit (FPU), all of which require more and faster external cache than a 486-class chip.

Upgrading an existing PC is one option that can be achieved through two methods. You can swap your motherboard—which may contain the processor, core logic, I/O, and often video circuitry—for another with a Pentium chip already installed on it. Another alternative is to install a Pentium CPU module—which may contain the processor and often cache—if your PC manufacturer offers one. (For a list of upgrade alternatives, see the chart.)

After buying a Pentium PC, the next best way to take advantage of the technology is to replace your motherboard with a Pentium-equipped motherboard, which will have the latest in support chips and quite likely VL-Bus or Peripheral Component Interconnect (PCI) sockets that your PC may not have. You will get the latest BIOS designed specifically for a Pentium system and a board that can handle the Pentium's heat. However, no off-the-shelf Pentium-

based motherboards are available: All the Pentium chips are being allocated to Intel's top few customers. They should be in ample supply by fall.

Many PC manufacturers that make upgradable systems—including ALR, AST, Compaq, Dell, and IBM—are creating Pentium-based modules for their machines. The advantage of using a PC manufacturer-produced upgrade

module is that such a module should be tuned to exploit the Pentium chip's advantages. But be forewarned: Of the upgrade modules offered so far, only Compaq's TriFlex architecture operates at 64 bits to the bus. The others are merely 32 bits wide, which means slower memory performance.

The best CPU modules will have not only the Pentium chip but also a new

Pentium Upgrades: A Company-by-Company Approach

Company	Model	Upgrade strategy
Acer America Corp.	Acer Acros	P24T
	AcerFrame 500	P24T
	AcerFrame 3000 MP	Pentium CPU processor board
	AcerPower 486e	P24T
Advanced Logic Research Inc.	ALR Evolution IV	P24T or Pentium CPU processor board
	ALR PowerPro	Pentium CPU processor board
	ALR ProVEISA	Pentium CPU processor board
AST Research Inc.	AST Manhattan SMP	Pentium CPU processor board
	AST Premium SE	Pentium CPU processor board
	AST Premmia	P24T or Pentium CPU processor board
Compaq Computer Corp.	Compaq Deskpro M	Pentium CPU processor board
	Compaq ProSignia	P24T
	Compaq Systempro XL	Pentium CPU processor board
Dell Computer Corp.	Dell 486L	P24T
	Dell 486M	P24T
	Dell 486ME	P24T
	Dell 486T	P24T
	Dell 4000/XE Servers	P24T or Pentium CPU processor board
	Dell PowerLine 450DE	Pentium CPU processor board
	Dell PowerLine 450SE	Pentium CPU processor board
Digital Equipment Corp.	DECpc 400ST	Pentium CPU processor board
Hewlett-Packard Co.	HP NetServer LE	P24T
	HP NetServer LM	Pentium CPU processor board
	HP Vectra 33ST	P24T
	HP Vectra 66ST	P24T
	HP Vectra 486M	P24T
	HP Vectra 486MI	P24T
	HP Vectra 486N	P24T
	HP Vectra 486NI	P24T
IBM Personal Computer Corp.	HP Vectra 486XM	P24T
	IBM PS/2 Model 90	Pentium CPU processor board
	IBM PS/2 Model 95	Pentium CPU processor board
	IBM PS/ValuePoint DeskTop	P24T
	IBM PS/ValuePoint Mini-Tower	P24T
NEC Technologies Inc.	IBM PS/ValuePoint SpaceSaver	P24T
	NEC PowerMate Image Series	P24T
Zeos International Inc.	Zeos 486 EISA	P24T

clock crystal (because Pentium chips run at either 60 or 66 MHz), an external cache, and system memory. In most cases, you'll need to update the BIOS, either with a software upgrade (if it's in flash memory) or by replacing the ROM chip.

The last upgrade path—and for now the least attractive—is to buy a system with a 238-pin socket that will eventually hold a Pentium OverDrive chip. There are two reasons for this: Unfortunately, the 238-pin Pentium-based Intel chip everyone is waiting for, code-named P24T, won't arrive until the end of 1994. In addition, there are indications that this upgrade strategy will not give full Pentium power because the P24T may not be able to support burst reads and writes.

This is not to say that the P24T will be underpowered or not worth waiting for: The problem is that because the chip hasn't arrived, there is no way to discern whether current systems will be able to use the chip fully. Some manufacturers may not support the P24T chip with all of the cache and other circuitry it really needs. Many of the systems with 238-pin sockets are 486SX and 486DX systems, not the more robust 486DX2 systems specified by Intel.

We don't know whether the P24T will have the dual-integer units of the standard Pentium chip. We do know that it won't have a 64-bit data bus because it will be used in 16- and 32-bit systems. In the meantime, Intel plans to develop other Pentium-design OverDrive processors, and it will probably have a clock-tripled DX3 33/99-MHz chip and a Pentium DX2 chip.

Some vendors are taking Intel's 238-pin strategy in stride. Dell, for example, installs the 238-pin socket on most of its systems, but on the 4000XE Server Series offers a Pentium CPU module that fits in the socket for those who don't want to wait. Acer uses a special version of the 238-pin socket that accepts not only the P24T but conventional 486 CPUs as well. □

it would have to be a small network indeed, since the 560ST offers just five drive bays (one internal bay is mounted under the power supply in the back of the case) and six 32-bit EISA slots. The 560ST's power switch is not lockable, but the reset button, mouse, and keyboard can all be locked. A rear-mounted key lock prevents unauthorized access to the internal system components.

The case is very solidly built and includes two fans and a 254-watt power supply. We were warned that the case cover must be in place or the chip will run the risk of overheating. A thermostatically controlled variable-speed fan that can move between 200 and 400 cubic feet of cooling air per minute is used to cool the motherboard and processor.

The motherboard was designed and

built in association with Intel. System memory is based on four 32-bit SIMM (single in-line memory module) sockets. If 16MB SIMMs are used, the motherboard maximum is 64MB. Another

128MB can be installed on an optional memory-expansion card for a system maximum of 192MB. When 32MB SIMMs become available, the 560ST's system maximum will increase to 384MB.

Benchmark testing proved the 560ST a quality performer, but not a stunner. The DEC SCSI-2 426MB hard disk and the Cardinal Technologies video board with an S3 chip helped the system post midrange scores. As usual with S3-based video, DOS video scores were low—the lowest in the group, in this case. The bottom line is that the 560ST performed in the middle of the pack on our Winmark, DOSmark, and Windows Application test suites.

If you're looking for a small server, the 560ST might be just the ticket, but if you want Pentium performance in a server, you're going to want to look for more drive and card space. As a single-user workstation, the 560ST is highly recommended. It combines the reassurance of a motherboard from the CPU chip manufacturer with a solid case and worldwide support.—OR

► DECpc 560ST

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD
Workstation replacement	GOOD



► FACT FILE

DECpc 560ST

Digital Equipment Corp., 50 Nagog Park,
Acton, MA 01720; 800-722-9332;
fax, 800-524-5694

Estimated list price (tested configuration): \$8,500

Memory and processor RAM cache: 16MB 80-ns SIMMs with 256K external cache

Disk drives and controller: Digital RZ25-E 14-ms 426MB SCSI-2 hard disk, Adaptec 1740A EISA card disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Cardinal EISA card video controller with 1MB of VRAM, DEC 15-inch SVGA Multisync LE (low-emission) monitor with a 72-Hz refresh rate at 1,024 by 768

Software: DOS 5.0, Microsoft Windows 3.1

In short: With its Intel motherboard, the 60-MHz DECpc 560ST is an impressive single-user system with impressive design features.

 470 ON-READER SERVICE CARD

Hewlett-Packard Co.

HP NetServer 5/60 LM

The size and quality of the HP NetServer LM have inspired what are now the system's watchwords: huge, solid, and built like a tank.

Featuring a sturdy case that has room for up to nine drive bays and backed with a 396-watt power supply, the NetServer performed quite well across a range of file and block sizes. Also noteworthy is the fact that it comes with interesting

HP NetServer 5/60 LM

SUITABILITY TO TASK

Scalability	GOOD
Security/fault tolerance	GOOD
Throughput/small block	GOOD
Throughput/large block	EXCELLENT



► FACT FILE

HP NetServer 5/60 LM

Hewlett-Packard Co.,
3000 Hanover, Palo Alto,
CA 94086; 800-752-0900;
fax, 800-333-1917

Estimated list price (tested configuration): \$8,100.

Memory and processor RAM cache: 16MB 80-ns SIMMs with 256K external cache.

Disk drives and controller: Two Seagate ST11200N 11-ms 1.05GB SCSI-2 hard disks with 256K cache, Adaptec 1740 EISA card disk controller, 1.44MB floppy disk drive.

Display: Integrated video controller with 512K of DRAM, HP D1197A 14-inch monitor with 72-Hz refresh rate at 640 by 480.

Software: DOS 5.0, Microsoft Windows 3.1., HP NetServer Assistant.

In short: With solid hardware, an array of high-end options, and strong performance scores, Hewlett-Packard's HP NetServer 5/60 LM is a good all-around choice.



server management hardware and software.

To keep the Pentium CPU from overheating, the system has three fans, including one mounted on the power supply. HP uses Intel's Xpress architecture for its motherboard and, like Digital, uses a motherboard and processor module designed and built in association with the microprocessor maker.

The NetServer more than adequately handled our network benchmark tests for small file sizes, and it excelled with 1MB files. The Xpress implementation has a couple of shortcomings, however. These include the 64-bit data path to the external cache, which compares unfavorably with the 128-bit path seen in other systems, and the 33-MHz (half the processor speed) main memory.

Pentium-Based PCs and Servers

List price (estimated) Because Pentium system prices had not been set at press time, the prices reported here are estimates.

Dealers/Direct-distribution channel Various machines are sold directly through mail order, through dealers, or through company-owned stores and superstores. Since discounting levels vary across channels due to industry-wide restructuring, *PC Magazine* quotes the manufacturers' suggested retail prices.

The **BIOS version (or date)** can affect the system's performance on *PC Magazine Labs'* benchmark tests. A machine with another BIOS may perform differently.

Flash memory contains BIOS code that can be updated via software. The BIOS is generally stored in conventional ROM, which has no provision for modification.

Cache architecture A *four-way set-associative* cache's data is split into four equal blocks; this type of cache is considered to be the most effective.

A *two-way set-associative* cache's data is split into two equal blocks, an organization scheme used on the Pentium's 16K internal cache. The data in a *direct-mapped* cache (the most common and least costly type) is not divided. The Pentium provides a separate cache path for instructions and data.

Cache write design A *write-back* design can cache data read from and written to memory. This method is theoretically superior to that of a *posted write-through* cache, which buffers all writes until the memory system bus is free before completing them, and that of a *write-through* cache, in which only reads from memory are cached.

Data path from cache to memory and from cache to processor is measured in bits. Larger data paths take better advantage of the Pentium processor, which has a true 64-bit data path as opposed to the 32-bit path on 486 chips.

Accessible drive bays can be reached from the system's front panel and can support removable media (such as tape and CD-ROMs); **internal drive bays** can be reached only by opening the case.

Floppy disk drives indicates the types of floppy disk drives the base-priced system contains. A *dual* floppy disk drive combines a 1.2MB and a 1.44MB unit inside a single drive bay.

Hard disk options We report the range of hard disk capacities the vendor offers for each system.

Disk controller location A computer with IDE (integrated drive electronics) circuitry has its controller functions integrated into the drive and motherboard but may have a separate controller.

Expansion bus For each type of expansion slot—8-bit, 16-bit, 32-bit, VESA, PCI, and proprietary—we report the number of slots on the motherboard. We also indicate how many parallel, serial, and mouse ports are integrated onto the motherboard, and the number of VESA, PCI, and proprietary bus slots each unit offers.

The **display circuitry** can reside on an expansion card or on the PC's motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade system video. We are also seeing an increasing number of video systems that rely on local-bus connections. We expect to see PCI systems in the near future.

DOS/Microsoft Windows 3.1 are often bundled with the vendor's systems. Where the features table indicates a *no* answer, this software may be available from the same vendor at an additional cost. In such cases, you can consult each product's fact file to determine whether the price cited for the tested configuration includes DOS and Windows. We have also begun to see systems bundled with DOS 6.0. A *yes* bullet for DOS implies DOS 5.0 except where otherwise indicated.

The **on-site service charge** is sometimes included in the price of the system, or it may be a set or variable added cost. Variable charges are often determined by the system's configuration and cost.

FCC Class B identification number Systems with a Class B rating from the Federal Communications Commission have sufficiently low radio-frequency emissions to be used in the home. To verify any system's status, you may dial up the Public Access Link, the FCC's own BBS, at 301-725-1072.

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INTRODUCING

PRO-NOTE™

Truly Portable. PRO-NOTE is the powerful, portable, high-performance pro you can take with you anywhere! Now you can have the storage solution that brings you real desktop computing power — with all the advantages of true portability.

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SMALLEST
PORTABLE
EXTERNAL
REMOVABLE
CARTRIDGE
DISK DRIVE

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Guaranteed Performance. PRO-NOTE comes with an unsurpassed two-year warranty on the drive and a five-year warranty on the SyQuest cartridge. And, you can reach our Customer Support Team toll-free at 1-800-536-7936.

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COMPUTERS
Pentium PCs

► **S U M M A R Y O F F E A T U R E S**

Pentium PCs

Products listed in alphabetical order

☒ = YES ☐ = NO	Acer AcerFrame 3000MP	ALR ProVEISA V	Compaq Deskpro 5/66M	DECpc 560ST	HP NetServer 5/60 LM	IBM PS/2 Server 95	Unisys PW² Advantage Plus 5606
List price (estimated)	<\$25,000	\$6,500	<\$8,100	\$8,500	<\$8,100	Info not available	\$10,000
Processor type and speed (MHz)	Pentium/60	Pentium/66	Pentium/66	Pentium/60	Pentium/60	Pentium/66	Pentium/60
Hard disks	Two 520MB	Four 120MB	One 510MB	One 426MB	Two 1.05GB	Two 540MB	One 1.2GB
Dealers/Direct-distribution channel	☒ ☐	☒ ☒	☒ ☐	☒ ☒	☒ ☒	☒ ☐	☒ ☒
Case style	Tower	Tower	Desktop	Tower	Tower	Tower	Desktop
Bus architecture	EISA	EISA	EISA	EISA	EISA	MCA	EISA
Power supply (and number of connectors)	500 (8)	300 (6)	240 (4)	254 (6)	396 (9)	400 (3)	200 (5)

Motherboard and CPU

Motherboard manufacturer	Acer	ALR	Compaq	Intel	Intel	IBM	Unisys
Chip set manufacturer	Intel	ALR, Intel	Compaq	Intel	Intel	IBM	TI
BIOS version (or date)	Acer 1.2R4.0	Phoenix 1.00.25B	Compaq (1/13/93)	Phoenix 1.00.07	Intel 1.00.06V0	IBM 1.0	Phoenix 1.0.02
Flash memory	☐	☒	☐	☒	☒	☒	☒

Memory and Processor RAM Cache

Installable RAM on motherboard	N/A	4MB–256MB	16MB–136MB	4MB–64MB	2MB–384MB	16MB–128MB	8MB–198MB
Cache architecture	Two-way set-associative	Direct-mapped	Direct-mapped	Two-way set-associative	Two-way set-associative	Two-way set-associative	Two-way set-associative
Cache write design	Write-back	Write-back	Write-through	Write-back	Write-back	Write-back	Write-back
Data path from cache to CPU	64-bit	64-bit	64-bit	64-bit	64-bit	64-bit	64-bit
Data path from cache to RAM	64-bit	32-bit	128-bit	32-bit	32-bit	64-bit	32-bit

Disk Drives

Accessible drive bays (5.25", 3.5")	4, 0	5, 0	3, 0	3, 1	8, 1	3, 2	3, 1
Internal drive bays (5.25", 3.5")	4, 0	1, 6	0, 1	1, 0	0, 0	2, 0	0, 1
Floppy disk drives	1.2MB	1.44MB	1.44MB	1.2MB, 1.44MB	1.44MB	2.88MB	1.44MB
Hard disk options	213MB–1GB	340MB–1.2GB	240MB–510MB	127MB–1GB	535MB–1.05GB	80MB–2GB	245MB–1.2GB
Disk controller location	EISA card	Motherboard	Motherboard	EISA card	EISA card	MCA card	Motherboard

Expansion Bus

8-bit, 16-bit, 32-bit slots	0, 2, 8	0, 2, 8	0, 0, 5	0, 0, 6	0, 0, 8	0, 0, 8	0, 0, 5
VESA, PCI, proprietary slots	0, 0, 6	0, 0, 2	0, 0, 0	0, 0, 2	0, 0, 2	0, 0, 1	0, 0, 1
Parallel, serial, mouse ports on motherboard	1, 2, 1	2, 1, 1	1, 2, 1	1, 2, 1	1, 2, 1	2, 2, 1	1, 2, 1
Integrated network adapter option	None	None	None	None	None	None	None

Video

Display circuitry location	ISA card	EISA card	EISA card	EISA card	Motherboard	MCA card	Motherboard
Video chip set manufacturer	ATI	ATI	Compaq	S3	WD	IBM	ATI

Miscellaneous

DOS/Microsoft Windows 3.1 included	☒ ☐	☐ ☐	☒ ☒	☒ ☒	☐ ☐	☐ ☐	☐ ☐
Warranty	1 year	5 years parts, 15 months peripherals and labor	3 years	1 year	3 years	3 years	1 year
On-site service charge	Included (90 days)	\$9.95 (1 year)	Included (1 year)	Included (1 year)	Included (3 years)	Included (3 years)	Varies
FCC Class B identification number	Pending	Pending	Pending	EJMX86D56	B9HHPL5102	Pending	Pending

N/A—Not applicable: The product does not have memory on the motherboard but comes with 256MB of RAM on a card

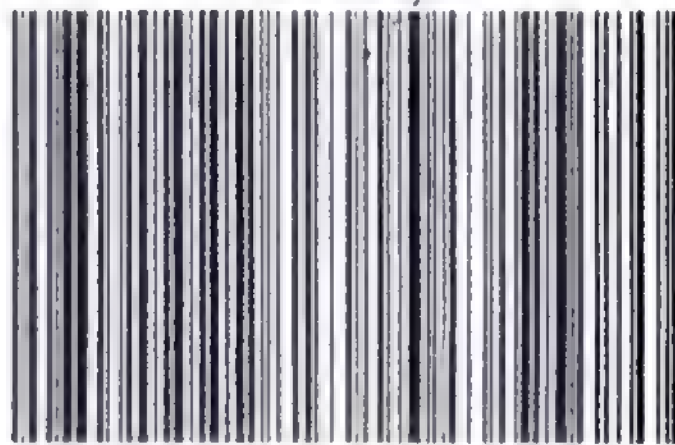
* DOS 6.0

ATI—ATI Technologies Inc., TI—Texas Instruments Inc., WD—Western Digital Corp.

1. Follow instructions on the other side

Back

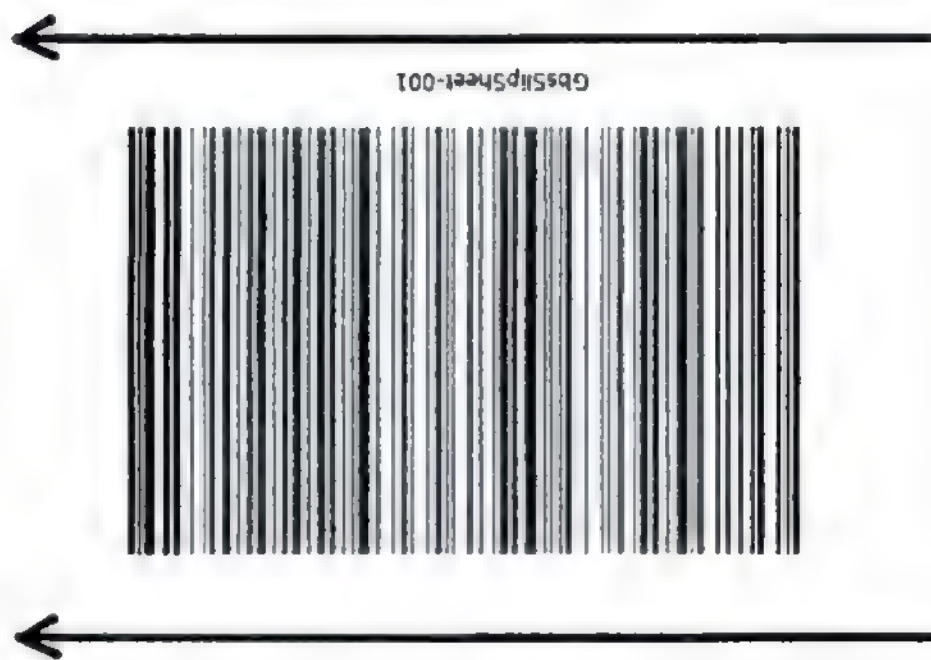
GBSSI Back-0018



Inverted Back

1. Follow instructions on the other side

Folded edge of the page



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

Smart enough to do things the only intelligent way: yours.

From the moment you plug it in, the new IBM LaserPrinter 4039 accommodates you—not vice versa. Compatibility with PostScript and PCL5 is built in—something other printers charge as much as \$775 for. So is SmartSwitch—to automatically select the right language for each job. And Lexmark's Quick Start installer and printer utilities make set-up brilliantly simple. And adding new fonts and drivers even simpler.



Lexmark's highly intelligent installer scans your disk for applications, then loads the right printer drivers, automatically. You're off to a smart start.



Smart enough to adapt to every corporate culture.

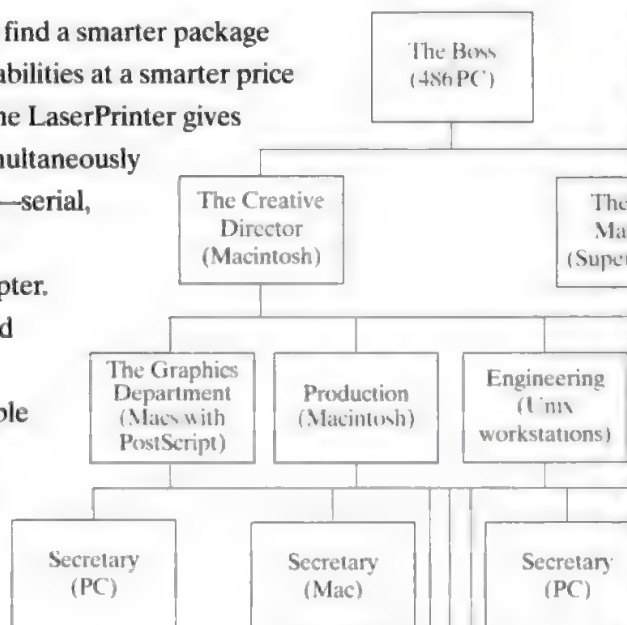
You won't find a smarter package of LAN capabilities at a smarter price anywhere. The LaserPrinter gives you three simultaneously active inputs—serial, parallel, and

optional internal network adapter.

Choose an optional INA card (Ethernet or Token-Ring) and you're simultaneously compatible with Novell® NetWare®, OS/2® LAN Server, Microsoft® LAN Manager, and AIX®—all on one card. AppleTalk cards are available for Macintosh networks, too. Add our 4033 external adapter, and you expand your LAN flexibility even further.

Lexmark INA cards have bi-directional communications, and flash memory, so a LAN administrator can check printer status and download new network software, without ever touching the printer.

Every LaserPrinter 4039 has a fast RISC processor. And you can choose speeds up to 16 ppm,¹ duty cycles up to 75,000 pages per month, and powerful paper-handling options. Because LAN printing demands brawn as well as brains.



*Mixed environments,
multiple networks,
changing languages—
nothing fazes the
LaserPrinter's
networking skills.*



Lexmark announces the next generation of laser printers. With the built-in intelligence to adapt to your needs today. And grow with you tomorrow.

The intelligent abilities of the new IBM LaserPrinter 4039 family
by Lexmark are powerful enough to impress the most serious user.
And economical enough to impress the most serious accountant.

Intelligence.

There are five new LaserPrinters, for
10, 12 or 16 page-per-minute printing.
Each has a fast-thinking RISC processor.
A compact, space-saving footprint. And an
optional snap-on duplexing attachment,
for the lowest-priced two-sided laser
printing in the industry.

PCL5 and PostScript® compatibility are
built in—saving you up to \$775 over competitive
machines. And delivering plug-and-play compatibility
that won't disrupt the way you're printing now. SmartSwitch
is built in, too—so your LaserPrinter can choose the right
language for each job, automatically.

Sharp, 600-dpi resolution is standard, with Print Quality
Enhancement Technology (PQET) for smoother curves. So is Picture-
Grade™ for sharper halftones.

Intelligent memory management lets two megabytes do the work
that used to take four. That saves you money.

Drivers for popular software packages are included, along with
Lexmark's special driver for faster Windows™ printing. So is



*A family of five highly
intelligent printers
that deliver 10, 12, or 16
pages per minute. And
a cost/value equation
that sets a brilliant new
industry standard.*

THE NEW IBM LASERPRINTER 4039

COMPUTERS

Pentium PCs

HP is loading the NetServer with high-end server options such as the two-line, 16-character LED (light-emitting diode) panel, which displays data on processor speed and special error codes. The NetServer can take a maximum of 256MB of RAM, or 348MB with the soon-to-be-available 32MB SIMMs (single in-line memory modules). This memory can be ordered with or upgraded to error-correcting memory as an option and works in conjunction with a 256K secondary cache.

The NetServer also includes a SCSI controller integrated onto the motherboard and a slot for an additional controller. The unit also features an 8GB drive-array option. The company claims that dual-Pentium options and an additional 10GB external array are in the works.

HP's new server management software, called NetServer Assistant, comes bundled with the NetServer and offers just about everything a network administrator would want, including diagnostics and remote control of server functions, as well as the consolidation of HP, Novell, and third-party utilities.

HP offers a new, three-year, world-wide, on-site service warranty to sweeten the deal.—OR

IBM Personal Computer Co.

IBM PS/2 Server 95

IBM wasn't the first to market with 80386- and 80486-processor computers, but its initial Pentium machine, the IBM PS/2 Server 95, takes a rightful place as one of the leaders on the new CPU platform. The high-scoring IBM server is designed and built for lasting performance.

The 66-MHz Pentium-based MCA (Micro Channel Architecture) bus system is at the top of the PS/2 Server 95 line. The tower case has a 400-watt power supply and two

fans, a variable-speed fan inside the power supply, and a cylindrical fan attached to the case cover. The drive-bay arrangement accommodates five external devices (three 5.25-inch and two 3.5-inch) and two internal 5.25-inch drives.

Indicative of this system's design quality, almost all component modules can be removed without tools. Even the power-supply bracket can be loosened by hand to tilt the power supply forward, enabling access to the SIMM (single in-line memory module) sockets (128MB motherboard capacity). Or you can loosen and remove the power unit completely. Another design nicety is a clear plastic guard that slides down over the case's front-mounted power switch in order to protect against inadvertent power interruptions.

IBM uses its own processor board for the PS/2 Server 95, including an Intel Cache 82496 cache controller chip and its own Pentium support chip set. The company also manufactures the SCSI-2 Fast/Wide hard disk controller and video adapter. These in-house components, plus a Maxtor 540MB 9-millisecond SCSI-2 hard disk with its own 512K disk cache, led the IBM unit to very high scores on our benchmark tests. The unit led the pack with its processor scores.

While we did not chart these scores, the PS/2 Server 95 performed exceptionally on our Windows disk tests. But it did not do as well under Windows video testing. On our network tests, the system came equipped with four IBM MCA Token-Ring cards, which the company calls "streamers." "Screamers" would have been just as appropriate; in I/O throughput—the true measure of a server—the IBM PS/2 Server 95 led the way.

We'd have a hard time justifying this admirable unit as a single-user workstation. But as a file server, the IBM PS/2 Server 95's MCA-based system shines, both in terms of performance and construction.—BB

HP's new server management software offers just about everything a network administrator would want.



FACT FILE

IBM PS/2 Server 95

IBM Personal Computer Co., Rt. 100,
Somers, NY 10589; 800-772-2227;
fax, 800-426-4329

Estimated list price (tested configuration): Information not available

Memory and processor RAM cache: 16MB 70-ns SIMMs with 256K external cache

Disk drives and controller: 2 Maxtor MXT-540S 9-ms 540MB SCSI-2 hard disks with 512K cache, IBM SCSI-2 Fast/Wide MCA card disk controller, 2 88MB floppy disk drive

Display: IBM PS/2 SVGA MCA card video controller with 512KB of DRAM, IBM 8515 13-inch monitor with 31.5-Hz refresh rate at 640 by 480

Software: None

In short: This IBM server combines exceptionally rugged design and construction with fast components



Unisys Corp.

Unisys PW² Advantage Plus Model 5606

With its Model 5606, Unisys is fleshing out its new PW² Advantage Plus series of Pentium-compatible PCs. Unlike the rest of the Advantage Plus line (Models 4333, 4666, and 4668), which can be upgraded to Pentium, Model 5606 starts out with one and provides better support for it.

Though you'll notice a sturdy desktop case that even has a 9-pin connector for communicating with an intelligent UPS (uninterruptible power supply), we noticed several design shortcomings, including noisy fans that rattled the case.

Inside, things were about the same as we saw with the other tested units. Everything necessary was there, but it all

IBM PS/2 Server 95	
SUITABILITY TO TASK	
Scalability	GOOD
Security/fault tolerance	FAIR
Throughput/small block	EXCELLENT
Throughput/large block	EXCELLENT

■ P6 and Beyond

Intel's plans for the next level of processor technology

by Mike Feibus

With all the hoopla surrounding the first Pentium systems, it's sobering to think that one day in the not-too-distant future we'll be yawning in the face of this chip's performance potential the way we now do with an 8086 or a 286. In fact, the P6 and P7 chips—the follow-on processors to the Pentium, code-named the P5 during its development stages—are well under way. Intel has assigned a team of engineers to each chip, and both teams are working simultaneously on chip design.

Intel is offering few details regarding the next two chips in the x86 lineage. Nevertheless, with history as a guide, astute Intel watchers can piece together a reasonable composite of these next-generation microprocessors and gain some insight into their computational abilities.

First, the P6's vital statistics will be impressive. The number of transistors in the P6—which should be introduced sometime in 1994—should rise to between 4 and 5 million. This compares with the Pentium's already prodigious 3.1 million transistor count and could translate into raw computing power of 200 MIPS (million instructions per second) for PC systems, compared with 112 MIPS for a 66-MHz Pentium system. If the P7 follows the historical timetable, it will be

the last generation of the x86 family introduced in this century. The P7, expected to be introduced around 1998, will come equipped with as many as 25 million transistors.

Architecturally speaking, the Pentium offers proof that the x86 programming model is fully matured. In fact, the last chip to contain major improvements to the architecture was the 386, introduced in October 1985.

With growing transistor totals, maintaining x86 compatibility is getting easier for Intel chip designers to handle. In fact, Intel estimates that only about 30 percent of the Pentium's transistors—or a million active elements—are devoted to keeping the current chip compatible with previous members of the x86 family.

With the programming model taking up less than a third of the Pentium's circuitry, Intel has a huge transistor budget to implement performance-enhancing features, such as those used in today's high-performance RISC-based processors. In fact, the Pentium's performance edge over the 486 is largely a result of the implementation of techniques such as superscalar processing, doubling the size of the data bus to 64 bits, and doubling the chip's internal cache size.

To be sure, there are more techniques available for P6 and P7, which will raise the performance potential

even higher. These include:

- Out-of-order execution of instructions, which boosts performance by letting the chip process continuously, rather than requiring it to wait for the results from certain operations before starting others.
- Register renaming, which is a way to transparently increase the size of the register set. (A major handicap of the x86 architecture is its small register set, experts generally agree.)
- Extension of the Pentium's superscalar capabilities beyond its cap of executing two instructions simultaneously.
- Implementation of a system of parallel processing units, each with the power of a virtual 386 CPU, on the chip.

What you probably won't see with the P6 or P7—at least in their first incarnations—is the incorporation of peripherals such as video and I/O electronics onto the CPU. This is contrary to earlier thinking. In the late 1980s, microprocessor experts predicted that the state-of-the-art processors introduced around the year 2000 would include every PC chip but memory. This level of integration would have encompassed everything from the core-logic chip set and graphics to wireless communications and multimedia.

Today, that prediction appears misguided. Intel and other vendors, it seems, will continue to focus on packing as much power as they can into their leading-edge processors. Integration is under way, but it's being used to merge older processors and support chips for mobile applications.

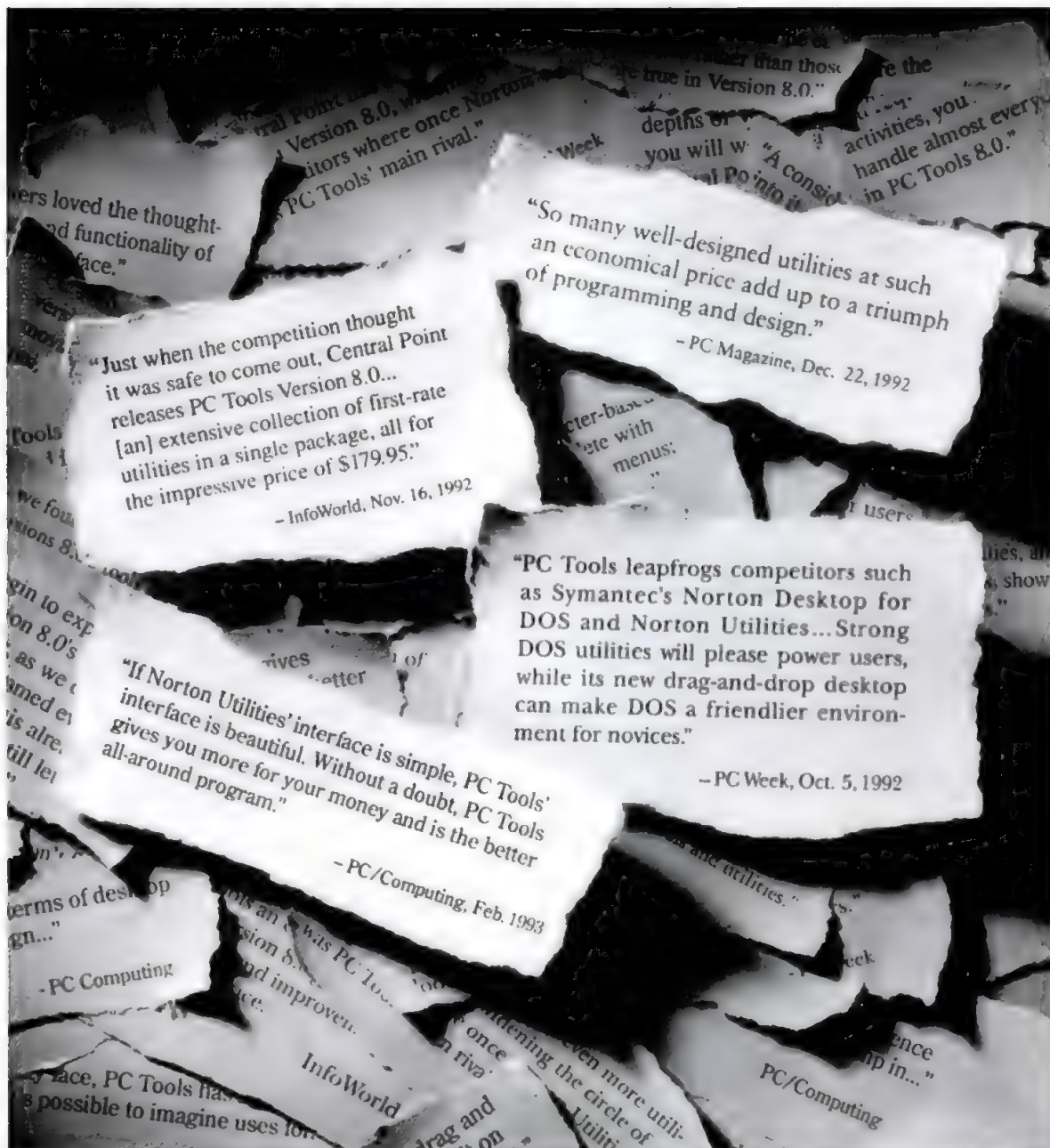
Using that rule of thumb, we should be seeing peripherals integrated onto the P6 about the time we're speculating on what P7's follow-on will look like—early next century. □

Successor to the Computing Throne: The Ascension of the P6

	486DX family	Pentium family	P6 family*
Number of transistors	1.2 million	3.1 million	4–5 million
Clock speeds	25–66 MHz	60–66 MHz	66–132 MHz
Performance (at 66 MHz)	54 MIPS	112 MIPS	200 MIPS
Cache size	8K	16K	32K–64K
Introduction date	1989	1993	1995
Size of electronic elements	1 micron	0.8 micron	0.6 micron
Chip size	165 square mm	294 square mm	550 square mm

* Expected configuration based on current knowledge.

We think PC Tools 8.0 will impress you.
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The CompuAdd DriveArray Top Performance Fault Tolerance For Thousands Less Than the Competition!

System Independent Data Storage

The CompuAdd DriveArray™ is completely software and hardware independent. It features five drive bays with up to 8GB capacity and a sixth bay for an optional spare drive or tape unit. And it costs thousands less than the competition!

Parity mode operation (RAID 5) has been revolutionized by a custom-designed ASIC that incorporates a parity generator. This innovation eliminates most of the performance penalty usually associated with RAID 5 operation by freeing the host CPU from parity generation tasks. The CompuAdd DriveArray boosts RAID 5 performance to near RAID 0 striping.

The CompuAdd DriveArray's RAID 5 mode also incorporates byte-level striping, a feature normally found in supercomputer RAID 3 arrays. This combination of single-cycle parity generation/write and byte-level striping enables the CompuAdd DriveArray™ to outperform standard RAID 5 set-ups, regardless of application or file size.

Cost-Effective Fault Tolerance

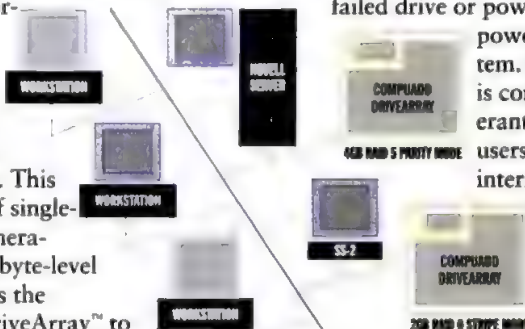
The CompuAdd DriveArray™ features a unique design power board that provides fault tolerance without requiring a separate power supply for each drive. In the event of a short circuit or component failure, the failed power supply is completely isolated from the power bus, the SCSI bus and the other power supply.

The CompuAdd DriveArray™ is

designed for "hot-swapping," replacing a failed drive or power supply without powering down the system. When the DriveArray is configured for fault-tolerant operation, network users will not notice any interruption of service from a hard drive or power supply failure or replacement.

Intelligent Operation Is Built-In

When a failed drive is replaced, the on-board controller monitors traffic and operates intelligently. When running in mirroring or parity modes, the CompuAdd DriveArray™ rebuilds data on a replacement drive completely in the background. When traffic is high, it keeps the recreation process at low priority. When traffic drops, the controller elevates the recreation function to high priority, rebuilding up to 50 times faster.



IT'S AN OPEN AND SHUT CASE.



Select The Mode That Suits Your System Or Network

Striping/ RAID 0 For Highest Overall Performance (2 To 4 Drives)

- Maximum 8GB using four 2GB drives
- Trades data protection for performance
- Fastest overall read/write speed
- Relies on other system (i.e. tape) for backup, data recreation

STARTS AT \$7495

Mirroring RAID 1 Offers Highest Data Protection (2 Or 4 Drives)

- Maximum 4GB using four 2GB drives
- Trades storage capacity for data protection
- Fastest fault-tolerant write
- Recreates data completely in background
- Four-drive mode incorporates block-level striping for higher performance

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SPECIFICATIONS

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COMPUTERS Pentium PCs

seemed sloppily installed. Cabling was a mess, so much so that closing the case without leaving some ribbon cable hanging out was a challenge. The shortcoming that stood out the most involved the Pentium processor module. Although this card contained all the standard amenities (processor, 256K external write-back cache, and clock crystal), Unisys's obsession with cooling backfired. A large metal cowl curves around the back of the card (where a dedicated fan is installed) to the front, so that air is funneled directly onto the processor. It looks like the air scoop on a late 1960s Mustang Mach 1. Though this setup will undoubtedly cool the processor, it also blocks an EISA slot—leaving only four available.

Though the Unisys unit's monitor was nothing special, its internal video circuitry was excellent.

Even a low-end workstation can need more than that.

The unit's video implementation was among the best we encountered, however. Though the unit's 14-inch Samsung SVG 200 monitor was nothing special, the internal video circuitry (based around an ATI 68800 chip), Unisys's local-bus design with 1MB of on-board video RAM, and a Brooktree RAM-DAC offering a palette of 256,000 colors produced excellent results on PC Magazine Labs' Windows benchmark tests. The unit

placed first in video performance and delivered strong disk scores. This excellent performance carried over into its scores on our Windows Application tests, where it completed our suite of four programs the quickest.

The unit's other results were also outstanding. Overall DOSmark scores, both with and without a 2MB software cache, ranked third and second, respectively, thanks mostly to the unit's well-designed disk and memory subsystems.

Though memory will only extend to 198MB on-board, the 64-bit path to the external write-back cache and 32-bit interface to main

dynamic RAM keeps this Pentium system well fed with data. The 1.2GB SCSI-2 Seagate hard disk is hooked to a motherboard-integrated Adaptec controller.

The rest of the unit's packaging offers some attractive features, including an integrated SCSI-2 connector (which also extends an external port), a UPS port, Flash BIOS, and several ROM-based security features. Unisys offers an internal local-bus Ethernet 10BaseT network interface as an option.

Unisys ships its product with a 12-month parts-and-labor warranty. On-site service is available for an additional fee.—OR □



FACT FILE

Unisys PW² Advantage Plus 5606

Unisys Corp., P.O. Box 500, Blue Bell, PA
19424; 800-448-1424, 215-986-4011;
fax, 215-986-6850

Estimated list price (tested configuration):
\$10,000

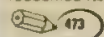
Memory and processor RAM cache: 16MB 70-ns
SIMMs, 256K external cache

Disk drives and controller: Seagate ST1050-FX1 13-
ms 1.2GB SCSI-2 hard disk with 240K cache, Adaptec
7770 Arrow integrated controller, 1 44MB floppy disk.

Display: Integrated ATI 68800 video controller with
1MB of VRAM, Samsung SVG 200 14-inch monitor with
72-Hz refresh rate at 1,024 by 768

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The unit had a few design shortcomings but
redeemed itself on most of our tests



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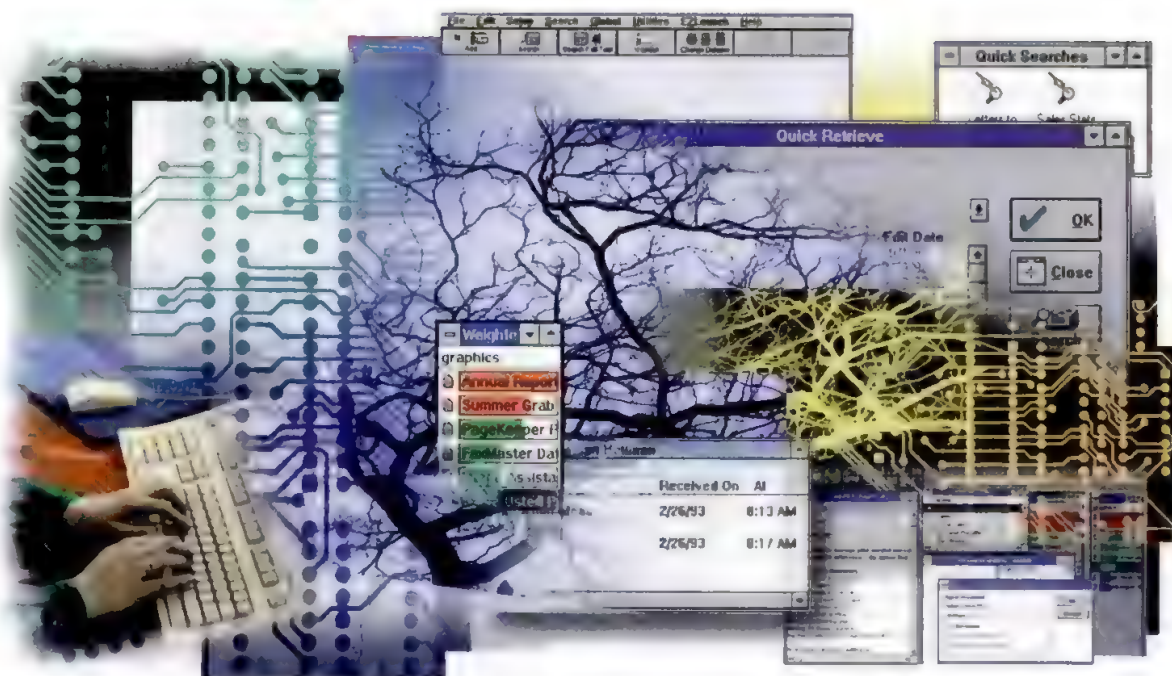
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DOCUMENT MANAGEMENT

The Painful Transition

These days, having to wait 30 minutes to retrieve a piece of critical information can be 29 minutes too long. A disorganized ocean of documents makes it difficult, if not impossible, to retrieve data that is critical to your company's survival. A document management system (DMS) can not only keep you from drowning in information, it can help you harness that information's power.

The term "document management" can refer to two types of systems. With the first you can scan and retrieve images of documents, which you index on user-input keywords; such products are usually referred to as document image management systems. The second type of system, which we look at here, allows you to track and retrieve live

When your paper trail turns into a paper snarl you can't seem to untangle, it's time to consider buying a document management system.

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by Gary Berline and Lori Grunin

Document Management

Suitability to Task: Document Management Software

The four packages we tested differ in their approaches to document management, ranging from those that offer fully customizable searches and reporting to those that offer a combination of traditional document management and workflow options. Your choice of DMS is largely a function of how you do your computer work.

To evaluate these document management systems, we put them through a full week of testing on a suite of document management-related tasks.

First, we tested these systems' enterprise conversion capabilities by importing and converting a large number of documents and then indexing them. Since many of these packages took a severe hit on their import facilities, we used a sliding test that ranged from 10,000 to 200,000 documents.

Next, we tested the packages' document-creation and version-control tools by creating a new document (complete with user profile), revising it, and then repeatedly checking it in and out of the system. We tested the speed and agility of the packages' text-search capabilities by searching for a text string in documents located on both servers, and for a specific word in spreadsheet files and in files from a particular date.

To see how well the DMSs would hold up under less-than-ideal condi-

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Installation and enterprise conversion				
Document creation and access				
System maintenance and reporting				

tions, we performed text-string and word searches while the server was stressed. We conducted routine document archiving and restoring, searched archived files, generated system logs and reports, and even corrupted our carefully created databases to see how well the systems would recover.

Our testbed consisted of two file servers running NetWare 3.11, connected via an Ethernet backbone. One server was a Compaq SystemPro with 32MB of RAM and a 2GB hard disk, connected to four Ethernet workstations, while the other was a Compaq Deskpro 486/33M with a 310MB hard disk, 8MB of RAM, and one workstation attached. We loaded dBASE IV 1.5, Lotus 1-2-3, Microsoft Excel 4.0, Microsoft Word for Windows 2.0, and WordPerfect 5.1 onto the workstations and the servers. We used the Gigatrend SL Turbo tape backup device to load and back up the servers, and the Jumbo Trakker 250 from Colorado Memory Systems for the workstations.

The 200,000 original documents used for testing varied dramatically in length, ranging from brief memos to lengthy proposals, and included a variety of standard word processor and spreadsheet formats. Ziff Communications Company employees Rich Belanger, Paul Ho, John Pinette, and Jerry Serio provided us with files, as did WordPerfect Corp.

In evaluating **installation and enterprise conversion**, we looked at how easy a package was to install and how successful it was at importing and converting a large number of documents. Speed and system stability were key factors here, as was ease of use.

To succeed at **text document creation and access**, a DMS had to be virtually invisible to the user, allowing the creation of new documents from within the system and tracking subsequent revisions. Also important were the flexibility and power of the search, retrieval, modification, and storage facilities, as well as security. The packages had to perform well over a multiserver local area network and maintain support for all search drives created by the LAN operating system.

How well a package handled daily maintenance tasks such as adding and deleting users, assigning access rights, archiving documents, and recovering from a crashed server determined its rating for **system maintenance and reporting**. Packages received a higher rating if they could generate customizable reports that did more than simply log user activity or if they provided analysis tools for improving network productivity and cost accounting procedures.

documents—those composed of text, graphics, spreadsheet information and other data types—based on full-text indexes of their contents. In the first type of system, the document is stored and retrieved as a graphic, while in the second, the document is stored as full-text even though it may contain graphics.

To be included in this story, the products had to support Novell's NetWare 3.11, be able to manage live documents created with major character-based DOS applications, have a built-in front end, and the ability to launch applications. The four products that met these criteria were Keyfile Corp.'s Keyfile Workgroup Edition, Version 2.0a; Saros Corp.'s Mezzanine, Version 3.0a (using the ViewZ for

Word for Windows for Workgroups front end); PC DOCS's PC DOCS, Version 4.1; and SoftSolutions Technology Corp.'s SoftSolutions 3.0 for DOS and 3.0a for Windows.

BRS Software Products' BRS/SEARCH (and BRS/WORD and BRS/VISION) met the letter but not the spirit of our selection criteria. Rather than being an off-the-shelf DMS, the products are custom solutions based on the number of documents you have and their types; conversions need to be specially

tailored to each installation, and these products only handle WordPerfect and ASCII documents. Document Administrator 3.0, from Information Management Research, fully met our selection criteria, but arrived too late to be included in this review. Global Integrated Systems' ReferencePoint, Version 3.0, didn't ship in time for this story, but should be out by the time you read this. (For more information, see the sidebar "Coming Soon: ReferencePoint 3.0.") Verity, which produces Topic, and Wang

Our Contributors: JOE SALLMI is a contributing editor to *PC Magazine*. GARY BERLINE, STEVEN C.M. CHEN, LORI GRUNIN, JAMES KARNEY, and STEPHEN W. PLAIN are frequent contributors to *PC Magazine*. GAYLE EHRENMAN was the associate editor in charge of this story, and JEFF MACE was the project leader.

Laboratories, which produces PC ProFound, chose not to participate in this review, because the company felt that it was oriented to a more intensive, enterprise-wide solution to managing documents and information.



EDITORS' CHOICE

• PC DOCS

DECLARATION OF INDEPENDENCE

Joining the refugees from mainframe-centric worlds such as accounting and statistical software, document management has taken the first two tentative steps down the ladder toward platform independence.

The first step, hastened by the demise of word processing giants such as Wang, was away from the proprietary mini-based word processor and toward the vertical-application PC market. Now, thanks to the confluence of this downsizing and LAN upsizing—predominantly via Structured Query Language (SQL)—these packages retain the power of their vertical-application roots while becoming about as off-the-shelf as LAN products ever get.

As for the next step, Mezzanine and the forthcoming PC DOCS Open (for more information, see the sidebar "PC DOCS Open: The Next Step") are the first to move toward open system architecture by switching from a proprietary database format and access language to the industry-standard SQL. With SQL, you can mix and match a proprietary database format with the nonproprietary access language that any SQL-speaking application can use. This approach also affords you with more flexibility in terms of interface and customizability.

An open system for document management is important because with a proprietary database, if you outgrow your current system, you face the possibility of having to reimport all of your documents and reindex the entire system—in other words, start from scratch. When you're dealing with 100,000 documents, the sheer complexity of changing systems can dissuade you from making what might be an important change.

OBJECT OF MY APPLICATION

In addition to using SQL as a universal query language, there are two other important trends in document manage-

Document management systems (DMSs) have rarely been called easy-to-use, but PC DOCS, Version 4.1, (from PC DOCS, \$495 per server, \$295 per user for full-text option) is the exception to the rule. It's as close to an out-of-the-box solution as you're

liable to find. Besides being easy to set up, PC DOCS is also incredibly easy to use. But don't be fooled by its pretty face: Beneath the surface lies a powerful document management engine that can track and control all file creation and editing, even over wide area networks. Its searches are powerful and fast, its reporting capabilities are flexible and sophisticated, and its enterprise conversion is both robust and speedy. In fact, PC DOCS proved to be the only package in this review that was able to import all 200,000 of our test documents.

SoftSolutions 3.0 for DOS and 3.0a for Windows (\$495 per server, \$295 per user) from SoftSolutions Technology Corp., are capable DMSs for small to midsize businesses that need to track documents on a mix of DOS- and Unix-based servers. They have

good search and reporting capabilities, but suffer from slow file importing and indexing and easy-to-circumvent document security.

Keyfile Workgroup Edition, Version 2.0a, (Keyfile Corp., \$2,995 for five users) falls short in traditional document management areas like file importing and version control, but does offer some unique workflow capabilities, such as document image routing.

Mezzanine, Version 3.01a, from Saros Corp. (\$299 to \$399 per user) is the only product in this review to rely on SQL for its database engine. Mezzanine has all the power you could ask for in a DMS, but can be inhibited by its interface. Mezzanine's biggest problem, however, is that it limits you to adding only 10,000 new documents per day.

ment. The first is the maturation of PC-based enterprise computing; the second is the birth of object-oriented software design.

Currently, document management (those products strictly designed for managing live documents) and groupware (products designed to be complete workflow solutions) exist as independent categories. Existing groupware products, such as Office.IQ from Portfolio Technologies, concern themselves more with managing the information distribution process than with managing the information itself, but the back-end technologies for efficiently managing files on a LAN or a WAN are converging for the two product categories. It's likely that their front ends will converge as well, with SQL as an enabling technology for the

transition. (For more information about groupware products, see "Groupware: Are We Ready?" in the June 15, 1993, issue of *PC Magazine*.)

On the surface, electronic forms packages (such as Delrina PerForm Pro) also seem to be fundamentally different applications, since they concern themselves with both data distribution and management. But they too share back-end technology with both groupware products and document management products, and their front-end technology—the idea of document as container—could prove quite useful for document management software design.

There appears to be a shift underway, however. Traditional document management packages like PC DOCS and SoftSolutions are being challenged by prod-

Document Management

ucts such as Keyfile Workgroup Edition that offer the best of all three categories: the workflow capabilities of a groupware package, the document routing of an electronic forms package, and traditional document management tools. Although Keyfile Workgroup Editions has some definite deficiencies when it comes to document management, its object-oriented interface design represents the future direction in which this product category will likely travel.

TO BUY OR NOT TO BUY

Given this market's state of flux, deciding whether or not you need a DMS can be as tough as deciding which one to buy. (For a guide to making the decision, see "Decision Tree: Finding The Right Management Solution.") Having trouble tracking and retrieving documents is the first sign that you need some sort of document management. But if that's your only problem, then a good file management product, such as XTree, might fulfill your needs.

You might not even need a standalone utility. Many word processing applications, such as Microsoft Word for Windows and WordPerfect, come with built-in summary boxes—for document titles, keywords, and a brief description of a document's contents—that you can use to track your documents; these are very similar to the profiles that a DMS generates. So for nonnetworked or single-server LAN use, the tools you already have may suffice. To track documents in a variety of file formats, products such as Caere Corp.'s PageKeeper, which allow you to track both text- and image-based documents (such as faxes), may suit your needs. (For more information, see the sidebar "Management Gets Personal.")

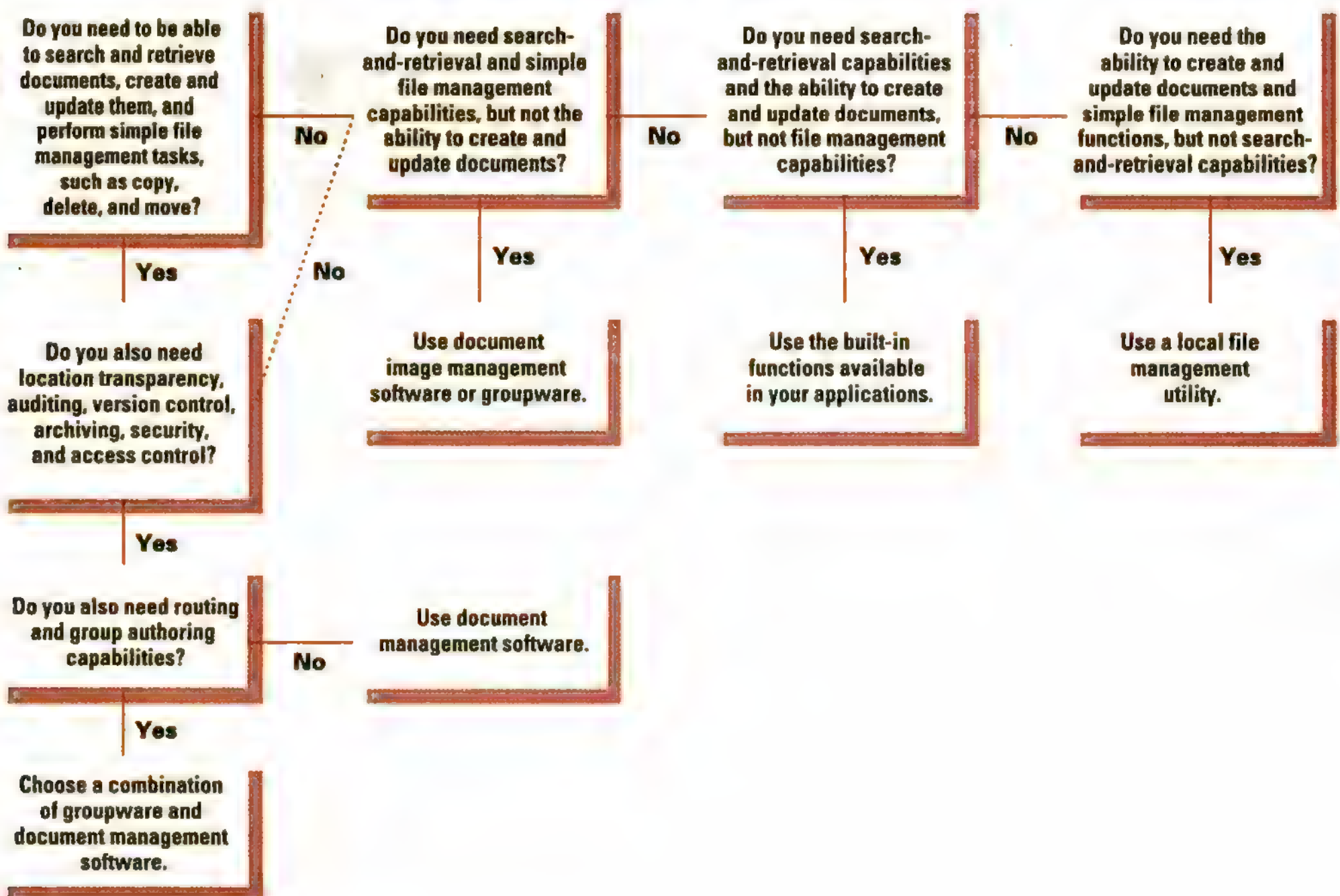
But if the complexity of your system has grown to the point where you need to archive documents, perform full-text and profile searches, keep track of multiple versions of the same document, retrieve documents from a multiple-server LAN or across a WAN, or manage a body of documents so large that your

mind boggles at its scope, then it's time to opt for a full-blown DMS.

Even if you do decide that you need a DMS, keep in mind that the technology still isn't a magic hat. You can't simply reach in and pull out an installation; usually there's a Value Added Reseller (VAR) hanging onto the other side. Like any enterprise application, creating a truly usable system requires hours of planning and design, as well as considerable expertise. Thus, many of the DMS vendors offer on-site installation and support; Saros, in fact, bundles the services of a human systems engineer with every sale to help with installation.

Although they're all designed to handle large numbers of documents, some of the tested products are more suited to converting existing installations (which are likely to have a large document base)—PC DOCS, for example, with its lightning-fast import and indexing. Others don't perform as well on the initial import and index, but are fast and flexible at managing those files created once the

Finding the Right Management Solution



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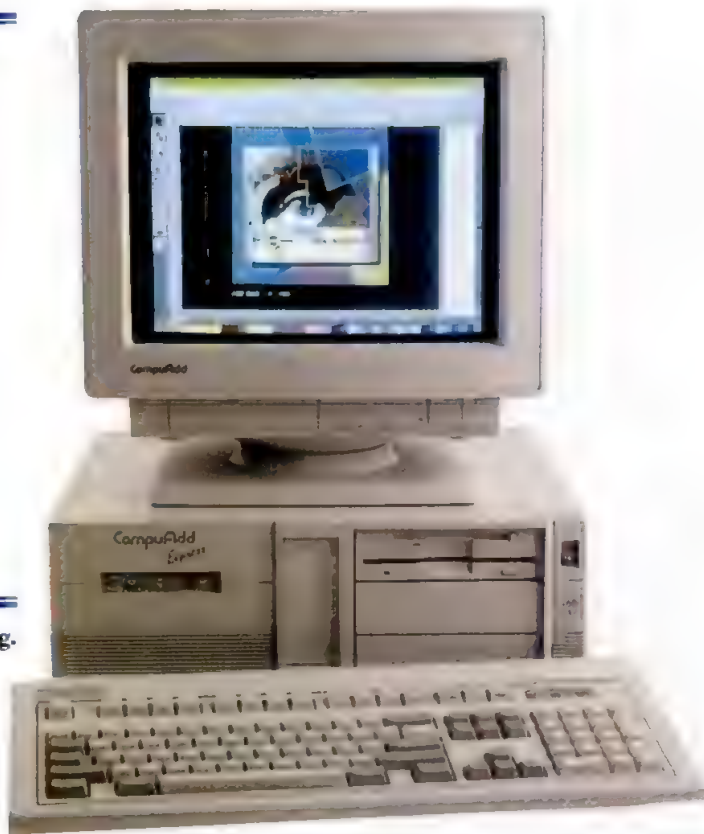
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Management Gets Personal

by James Karney

Keeping track of information today using DOS's aging file system is like trying to keep the records for a 500-employee firm in a shoe box. To handle this situation, big firms use high-powered document-imaging and document management systems for their mainframes and networks. For those who don't have a network or the skills to run one, personal document management software can bring the power of organization to the desktop.

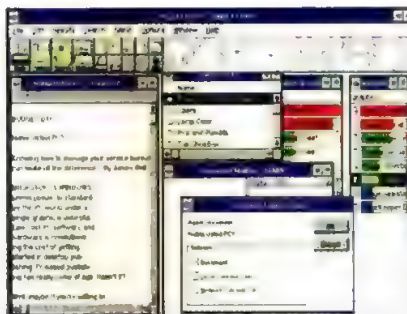
Most of these personal solutions fall into one of two categories: document- and image management systems (DIMS) that have some full-text capability or dedicated, full-text search-and-retrieval systems. Some are designed for one user; some can be shared on a network. In general, none yet offers the reporting and file-monitoring capabilities of a full-fledged Document Management System (DMS).

If your documents come in a variety of types, ranging from, say, scanned-in text and graphics to faxes or word processing documents, you'll want to consider a multipurpose image-based system, such as PageKeeper or Recollect, both of which run under Microsoft Windows, Version 3.1.

PageKeeper, from Caere Corp. (100 Cooper Ct., Los Gatos, CA 95030; 800-535-7226), is an \$895 DIMS that uses the company's OmniPage OCR (optical character recognition) engine to turn scanned-in files into editable documents. In addition to scanned files, the package also lets you collect word processing files, faxes, graphics, and e-mail into one searchable database. Its full-text search feature lets you find documents using Weighted Relevance Retrieval, with which hits are automatically weighted in what the program considers order of importance.

PageKeeper does have some drawbacks. The OCR engine can be slow, indexing can be time consuming, and

the database can rapidly consume all your disk space. Also, since you're not required to add all your documents to the system, its retrieval abilities will only be equal to your diligence. It can be a handy tool for projects requiring small reference libraries and—since it can run over a network—may be a perfect first step for small firms experimenting with document management.



PageKeeper offers many features found in full-scale network document management systems.

Recollect from MindWorks (735 North Pastora, Sunnyvale, CA 94086; 408-730-2100) is a standalone \$795 DIMS package incorporating the same OCR engine as PageKeeper. Also like PageKeeper, it can be used to scan and convert hard-copy files and faxes, as well as catalog images and word processing and electronic files. The package creates a full-text index as each file is converted and lets you attach a 32K note file to each document. Recollect is better suited for applications involving image archives rather than document access, since it puts more emphasis on bitmapped images and imported documents than it does on tracking file creation and location. The program provides several compression techniques to reduce the storage required, but be aware that even compact bitmaps can consume a lot of disk space.

Not all of the programs in this group focus on the document: Applications such as askSam and Windows Personal Librarian center their tools on the in-

formation. They excel at fast full-text searches and often find useful information you didn't know you wanted. With these products, file location is not as important as content and its relation to your query. Several document management systems are currently in development, including PC DOCS Open, which will link to similarly robust third-party full-text programs.

Windows Personal Librarian (Personal Library Software, 2400 Research Blvd., #350, Rockville, MD 20850; 301-990-1155) is an electronic assistant that quickly finds the information you need. Priced at \$995, it offers the most sophisticated search capabilities of any product in this roundup. It can index ASCII, Microsoft Word, and WordPerfect files and then use combinations of natural language, fuzzy logic, and context searches. Windows Personal Librarian can also expand and contract topic lists to locate information and suggest options for additional queries. Personal Library Software offers companion versions that can share indexes running on DOS, Unix, and Macintosh platforms.

At \$395, askSam for Windows (askSam Systems, P.O. Box 1428, 119 South Washington St., Perry, FL 32347; 800-800-1997) is a full-text engine with a built-in word processor that can import and export ASCII, WordPerfect, and Rich Text Format files such as those used by Microsoft Word and Lotus's Ami Pro. You can develop queries either by using menus or with a command language. This dual structure lets you use the program as both a retrieval system and a freeform database. In addition, you can use OLE (Object Linking and Embedding) to add multimedia fields to your database.

All of these products can help you recover from information overload. The key to a perfect fit is knowing your own work habits and the kinds of documents you need to manage. □



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Document Management

system is in place. SoftSolutions, for example, provides excellent version-control capabilities.

Administering a system requires automatic and detailed reporting and auditing, easy day-to-day maintenance (including addition and deletion of users, rights modification, and file archiving), sophisticated security configuration, and straightforward application integration.

Remember, though, that even the easiest system to administer will be useless if the package is so intrusive that the user will continually attempt to circumvent it. A DMS requires a profile of every single document; this duty falls to the already-overburdened end user, who also has the least incentive to perform this task. A good system will allow a user with an immediate job to delay updating the profile, or will keep profile histories so that the user doesn't have to reenter recurring data. Document locations should be transparent to end users as well, who shouldn't need to know that the memo they want is located in the directory Q:\METRO\PLANET\KENT\ on the server LUTHOR in the Metropolis office, regardless of the limitations of the network operating system.

If you're poorly organized, buying a computer simply makes you a poorly organized person with a computer. By the same token, a document management system alone can't undo your company's information snarl. But a well-implemented DMS can, at the very least, untangle the knots.

Keyfile Corp.

Keyfile Workgroup Edition

BY STEPHEN W. PLAIN

With its virtual desktop full of icons, Keyfile Workgroup Edition, Version 2.0a, looks more like a GUI operating environment than a document management program. If you simply want to get a grip on a huge number of existing documents and make them available for reference, Keyfile is probably not for you. But if your organization is full of Microsoft Windows users and your aim is to make centralized document management part of their normal operation, this unique environment can improve productivity.

The \$2,995 Workgroup Edition of Keyfile includes a Windows-based document server and supports five Windows users. A \$4,995 OS/2 version of the document server component is available for larger installations. Enterprise Edition Desktop, the desktop software for Windows users that attaches to the OS/2 server sells for \$995 per user.

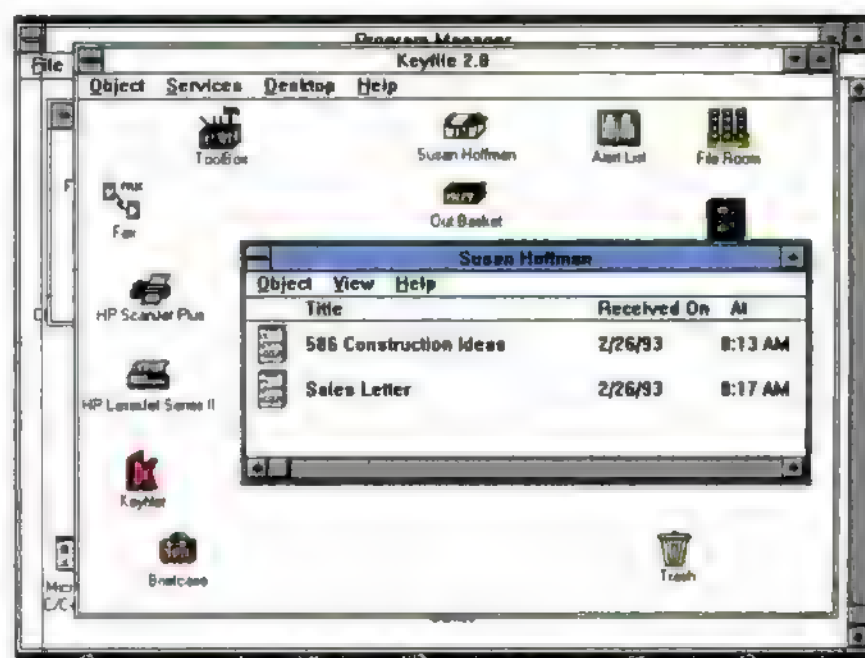
Keyfile uses a client/server architecture to handle documents ranging from incoming faxes to archived storage through their entire life cycles.

The Document Server component runs on a single PC and manages Keyfile's proprietary object-oriented database. This database stores all of the system's objects within large-volume files that can be located on the same system or on a high-capacity file server. Each user runs the Keyfile Desktop, which is visually similar to OS/2, either locally or from a file server.

ICONS AND OBJECTS

Since Keyfile uses such easily recognizable objects as folders, file cabinets, and in/out boxes, users can customize their desktops to mimic existing paper-based operations. You can add icons representing various scanners, fax boards, printers, and sound boards, and have them all conform to a consistent drag-and-drop environment.

Keyfile comes as close to the elusive "paperless office" as any system you will find. For example, a marketing department could incorporate information from incoming faxes into a document and then, through a unique feature called Tiff-it, produce an application-independent TIFF image of the document. This image can then be dropped on top of an icon representing a distribution list of managers whose approval is needed. The managers in this custom work flow list could then mark up the TIFF image of the document and send it back. When the document arrives in the marketing repre-



Keyfile Workgroup Edition's desktop comprises objects used in traditional paper-based offices.

sentative's in-box, she could incorporate the comments and send the document on to the production department to be printed, complete with voice-annotated instructions.

Keyfile is as easy to install as any Windows application, but the success of your implementation requires careful planning. The four manuals making up the documentation fall just short of adequate in explaining the various aspects of the system. The system creates objects for everything, from users to applications. During user setup, an administrator does these objects out to users by dragging icons from the Master Toolbox to each user's individual Toolbox.

You can assign various security restrictions to any object and create security groups such as "Management Only." Each object has associated properties, including the security group to which it belongs, that are always available by clicking the right mouse button.

DOCUMENT HANDLING

Out of the box, Keyfile can index manually entered keywords. A standard search form lets you locate documents by keyword, author, and date range. You can build searches upon one another to narrow down the selection set, but searches on phrases are not effectively supported. Support for fuzzy searches or conceptual retrievals is also lacking.

SUITABILITY TO TASK

Keyfile Workgroup Edition

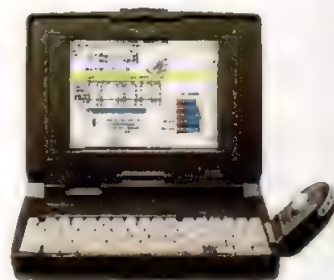
	POOR	FAIR	GOOD	EXCELLENT
Installation and enterprise conversion	●	●	○	○
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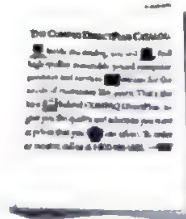
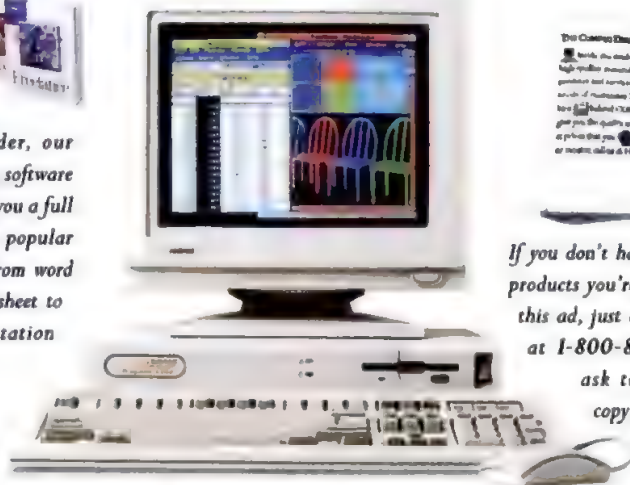


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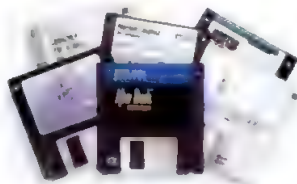
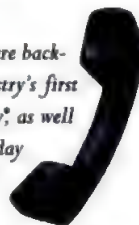
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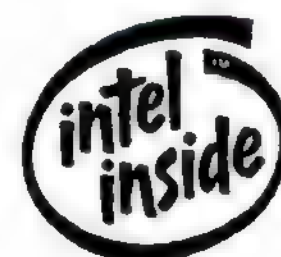
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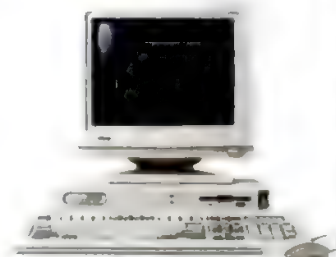
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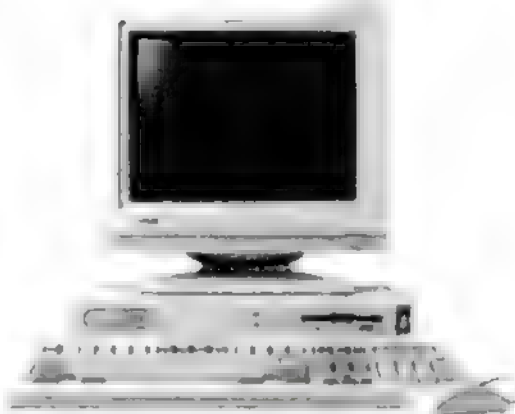
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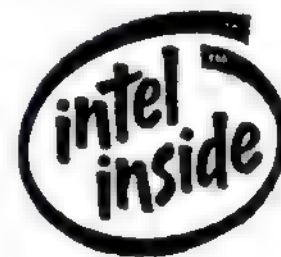


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Document Management

Keyfile is not designed for massive enterprise conversion—its import option only handles up to 50 documents at a time—but we found that it could import our 200,000 files, albeit with some effort and a great deal of time. Because of the time hit, we stopped after importing 10,000 files. To make even this level of document importation possible, we used a prerelease version of a batch import utility developed by Keyfile Corp. that is available to customers upon request. This utility, written in Visual Basic, communicates with Keyfile via DDE (dynamic data exchange) and enables the program to import and index whole directories of files. However, in our tests the utility worked with only varying degrees of suc-

cess. This is an example of the type of customization you will find necessary to fully implement Keyfile for your operation. You'll also need an external application to customize the fields of the profiles associated with documents.

Keyfile's weakness is its lack of the robust traditional functionality usually associated with document management. For example, there is no built-in version control mechanism. Using Keyfile's Koala, a limited scripting language, we were able to create a custom tool for version control, but this task required many lines of hand-typed code and more than a little ingenuity.

Since tasks like these are bound to come up in any organization, the limita-

tions of Koala are disappointing. Although the language is designed to emulate menu selections, it has no keystroke recorder feature, and its lack of support for memory variables and traditional programming constructs significantly limits the Keyfile environment's possibilities. To fully exploit Keyfile, you'll need a Visual Basic, PowerBuilder, or GUI programming language expert to do your customization.

GUI EXTRAS

You can configure a wide variety of common applications as icons to be launched directly from the Keyfile desktop and associated with document file extensions. Documents created from within Keyfile-

PC DOCS Open: *The Next Step*

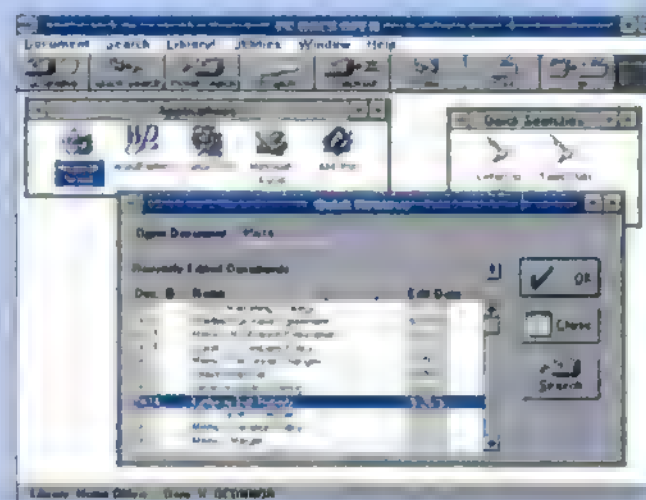
by James Karney

The document management software market is poised for major change. Unlike past systems, which were designed around a tightly controlled environment, today's systems need to be able to run on a variety of networks and across a variety of different operating systems, as well as manage files from a variety of applications. Though such software does not yet exist, PC DOCS is moving in that direction with its latest offering, PC DOCS Open, which should be available by the time you read this.

This product is designed with an open architecture that gives it a flexibility that PC DOCS, its DOS-based older sibling, lacks. What "open" means is that this system can run on almost all Windows-compatible LANs and use all the leading engines based on SQL (structured query language) for its database. Pricing for the system varies based on the database engine you choose, but the standalone version of PC DOCS Open is expected to retail for \$295. DOS and Macintosh editions are now under development.

Whereas PC DOCS is tightly integrated with WordPerfect, PC DOCS Open works very well with most Win-

dows applications and follows the Common User Access design in its interface. We used it as a front end on a system with Lotus 1-2-3, Lotus's Ami Pro, Microsoft Excel, Microsoft Word for Windows, WordPerfect for DOS, WordPerfect for Windows, and other applications. To be fully integrated, the target application must support Win-



PC DOCS OPEN allows you to use its advanced features with a variety of applications.

dows DLLs (dynamic link libraries) in their macro language. E-mail, fax programs, and other communications products can be integrated.

The only real drawback to this system comes when dealing with Windows' multitasking ability. PC DOCS can capture any attempt to create or save a file; PC DOCS Open can't. Also,

you can fool the system by modifying the file-creation macros for a particular application, but that requires a level of expertise and effort beyond the realm of the average user.

What's attractive about this system is its power, ease of use, and flexibility. The document management and retrieval functions are just a mouse click away. You can totally customize document profiles by editing directly on the dialog box. The interface uses a toolbar that can also be modified to suit your tastes and work habits, letting you execute searches, view documents, or send faxes without opening a menu.

PC DOCS Open has the same snappy response to searches as its sibling. The program uses the SQL database for fielded data and a second engine tuned for full-text operations. The full-text mode is enhanced with the addition of relevance ranking and some conceptual search features. Frequently used searches can be saved and rerun with ease. For even more power, it will link to third-party products such as Windows Personal Librarian.

PC DOCS Open may not solve all your document management problems, but it does provide new features and solid performance. □

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Document Management

FACT FILE

Keyfile Workgroup Edition, Version 2.0a

Keyfile Corp., 22 Cotton Rd., Nashua, NH 03063; 603-883-3800; fax: 603-889-9259

List price: \$2,995 for five-user version; \$4,995 (plus \$995 per workstation) for larger installations

Server requirements: 386SX or better, 6MB RAM, 12MB hard disk space, DOS 3.31 or later, Microsoft Windows 3.x

Workstation requirements: 386SX or better PC, 4MB RAM (6MB recommended), 5MB hard disk space (10MB recommended), DOS 3.31 or later, Microsoft Windows 3.x, Novell NetBIOS, VGA or better display.

In short: Based on a next-generation object-oriented database, Keyfile Workgroup Edition offers a unique alternative to document management for Windows users. It lacks some of the search and reporting capabilities of its competitors, but its distinctive workflow features and consistent drag-and-drop interface make it easy to master for just about every Microsoft Windows user.



launched applications are automatically saved in the system's database. Future versions of Keyfile will use OLE to let users drop documents directly onto the Keyfile desktop from the Windows File Manager.

Applications are set up by means of .BAT files for DOS applications and .WIP files for Windows files. The .WIP files, similar to Windows .PIF files, control such things as multiple instances of an application and DDE communications to Keyfile. Sample .BAT and .WIP files are included, but we had to work with technical support to get them to operate with the particular versions of Lotus 1-2-3 and WordPerfect that we used for testing.

If all you want to do is look at a document, Keyfile's built-in viewers will let you examine original documents from over 80 popular programs. You can also view graphic input from scanners or fax servers directly from Keyfile without launching an application. Converter tools are included to convert between a selection of graphic and text formats and, if you have Mastersoft's Word for Word Professional, you can convert between all of its supported document types. With

that software installed, you can also perform full text indexing of the original document formats.

With an optional \$995 software driver, you can associate an optical drive to a file cabinet for automatic document archiving. Once a file cabinet is set up for archiving, any documents dropped into it are automatically written to the appropriate optical volume. Keyfile leaves an image of each archived document on the hard disk, and a background Sweeper process purges the image after a user-specified period of time. Similarly, whenever a document that exists only on the optical drive is called for, a copy is loaded back into live storage. This system provides transparent archiving and eliminates "off-line" storage.

Administration of the system is simple because of the object orientation, but there's a noticeable lack of logging and reporting tools. While the granularity of logging can be adjusted at the document server, much of the log file is indecipherable and seems to be designed more as a diagnostic tool for working out problems with Keyfile technical support than as a means of monitoring system activity.

There are no reporting facilities per se, but some statistics can be generated by conducting searches. You can generate a table of contents of objects within a folder or file cabinet and print it out for quick statistics on who has which files and where. Unfortunately, Keyfile has a limit of around 4,000 objects that can be listed at one time within a folder.

Keyfile operates on NetBIOS, so it peacefully coexists with Microsoft LAN Manager, NetWare, VINES, and other popular networks. Although the documentation doesn't specifically state that the document server needs to be dedicated, we found that switching between applications within Windows while Keyfile was running destabilized the system. Since all access to the object database is made through this system, you should be prepared to dedicate a 486-class computer to running the document server.

To qualify as a full-fledged document

management system, Keyfile needs more mainstream features and added flexibility. However, its GUI operating environment, underpinned by a sophisticated object-oriented database, may be a glimpse into the future of document management. If your Windows-based organization is ready to take the plunge into an entirely computerized workflow system, Keyfile Workgroup Edition is a reasonable choice.

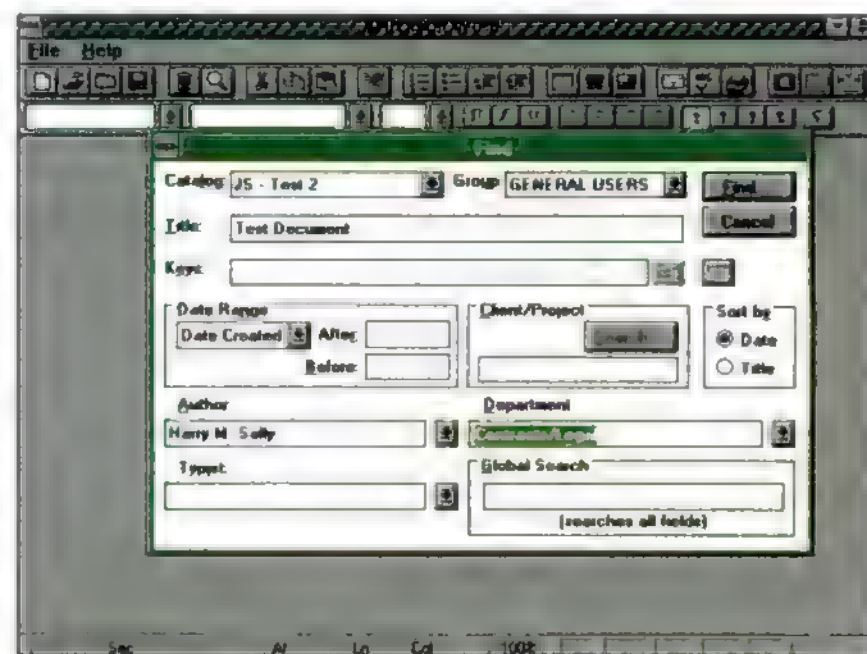
Saros Corp.

Mezzanine

BY JOE SALEMI

Mezzanine, Version 3.0a, from Saros Corp., is unique among the products reviewed here because it's currently the only one to use a true client/server architecture. The document manager database engine is based on Saros's adaptation of Microsoft SQL Server, Version 4.2. This is Mezzanine's greatest strength—and its greatest weakness.

The advantage of this approach is that the client/server architecture doesn't limit the program to a single user interface. Anyone with the Mezzanine development kit can write a front end, and many good ones exist. We primarily tested Mezzanine with Gilbert and Asso-



The ViewZ front end to Mezzanine tightly integrates itself into the user application.

ciates' ViewZ for Word for Windows, which Saros bundles with its package. Other application-specific versions of ViewZ are also available. The flip side to the client/server approach is that Saros can only support the networks and operating systems that SQL Server supports.

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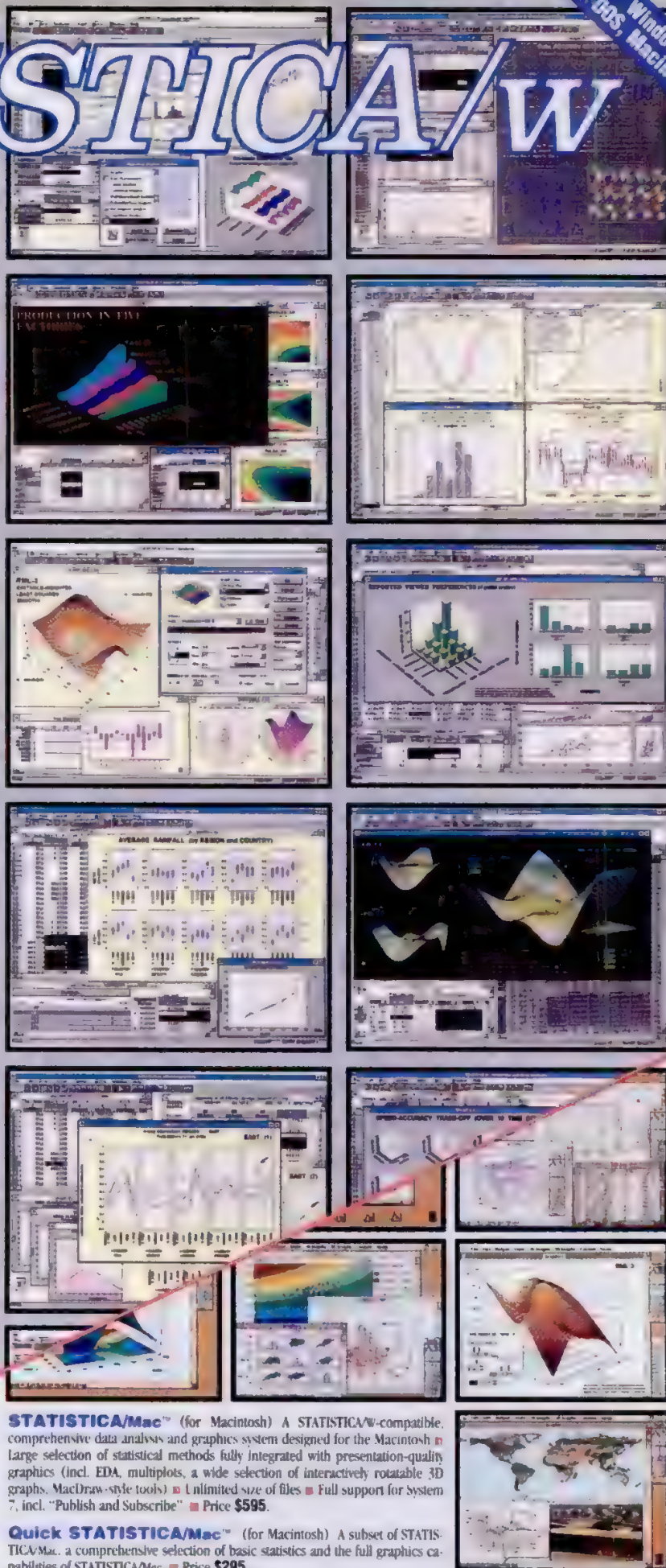


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CIRCLE 029 ON READER SERVICE CARD

Mezzanine, which is aimed at Fortune 500-type companies with 500 or more users, is one of the more expensive products reviewed here when purchased in small quantities. For fewer than 49 users, the package costs \$399 per user; for 300 to 999 users the price drops to \$299 per user. For 1,000 users or more, the price is negotiable. The fee includes a site-licensed copy of the database engine that can be used on as many servers as necessary.

SETTING UP THE SERVER

Setting up the Mezzanine server is a complex process, but you won't be doing it

SUITABILITY TO TASK				
Mezzanine				
	POOR	FAIR	GOOD	EXCELLENT
Installation and enterprise conversion	●	●	○	○
Document creation and access	●	●	●	●
System maintenance and reporting	●	●	○	○

alone. As part of the initial purchase, Saros sends one or more technicians to your site to help you get the system up and running. The server has to be installed on a machine running OS/2 1.3—Microsoft SQL Server was not certi-

fied for OS/2 2.0 at the time of this review, and our attempts to run the server on 2.0 were unsuccessful.

In addition, you'll need the right OS/2 drivers for your network operating system, including the drivers for the Named Pipes protocol that the server uses to communicate with its clients. Our test installation used NetWare 3.11 with the latest version of the Named Pipes driver. Mezzanine is also certified to run on 3+ Open networks, IBM LAN Server, Microsoft LAN Manager, and Banyan's VINES.

Mezzanine server software is modular, and document management tasks can be split among two or more servers in a distributed processing environment. Documents are stored in subdirectories that Saros calls shelves. The main server module, called the Shelf Server, manages the document profiles and profile indexes and decides where documents are stored. The indexes are kept on the Mezzanine server, but the documents can be stored on any drive to which the server has access. Shelf Servers can be run on multiple machines and can communicate with each other to let users access multiple shelves through a single connection.

For full-text indexing and searching, Saros provides a licensed version of the Fulcrum text engine, which it calls the context server. It can also run with a variety of other search engines, including Verity. The server automatically indexes files as needed, so while a LAN needs only one context server, that server needs sufficient disk space to store the text index. The minimum disk space required is 40MB, but Saros recommends at least 300MB.

Mezzanine has some serious limitations when it comes to importing existing documents. The scheme it uses to store the documents is based on the date of document creation, and it's limited to adding only 10,000 new documents a day. However, we ran into many problems importing our test documents into the server, and were able to import only about 6,700 during five days of around-the-clock importing. According to Saros, the problem was generated by data overflows in the NetWare Named Pipes drivers, which caused the connection between the client and the server to drop.

■ Coming Soon: *ReferencePoint 3.0*

by Steven C.M. Chen

ReferencePoint, Version 3.0 (in beta at the time of this roundup but most likely available by the time you read this), is full of potential but falls a bit short in execution. Global Integrated Systems (P.O. Box 1948, Orem, Utah 84059; 800-374-6805), which acquired ReferencePoint from Intel Corp. in November 1991, has made several improvements to the previous version, but more polishing is needed.

This \$199 package features a NetWare Loadable Module (NLM) and boasts a well-designed desktop user interface in both its DOS and Windows versions, but its enterprise conversion procedures make it a nightmare for the document administrator. New to Version 3.0 is a server-based NLM for daily indexing and on-line help for the administrator utility. ReferencePoint still uses Btrieve as its search engine and allows only a single database.

ReferencePoint Desktop is a straightforward user interface with a pull-down menu and mouse support in both the DOS and Windows versions. You can search for a document by using any of its profile parameters (all of which can be saved) or by using the 16 user-defined fields. One small drawback is that Desktop lists the files but not the number of matches. The browse feature only displays an ASCII document without highlight-

ing the matches, which can be a problem with a large file.

If you create files outside of ReferencePoint, be prepared for some extra work: You have to use DOS or the Windows File Manager to bring these documents into your personal work area and then process them one at a time. There are no batch conversion capabilities built in.

The DOS-based installation program offers only a basic service for copying files. Because ReferencePoint doesn't read a Novell bindery, users and groups must be created manually.

The administrator program creates a profile or reference card for each file. This process, which the product calls synchronizing, created 65,000 unnecessary files during our tests and required 26 hours to generate the profile database.

After the database is created, files are indexed via FULINDEX.NLM, which processes files using information in the profile database, or via LANINDEX.NLM, which adds information to an existing database. But the administrator program uses the same files as LANINDEX.NLM, which caused database files to periodically lock up when we tried to use the two programs simultaneously.

ReferencePoint is a step in the right direction, but, ultimately, it still has a long way to go. □

Document Management

THE CLIENT SIDE

Installing the client side software is simple. The two front ends we looked at run under Microsoft Windows 3.x and have their own setup programs. The FileShare utility (called ARCHIVz), which is primarily designed for configuring and administering the server, uses a combination of index card-type screens and icon-driven dialog boxes to examine, enter, and change user and server information. Access rights can be assigned on a group basis, and users can be part of more than one group. Most maintenance functions, such as backing up the database and documents, can also be performed through FileShare. One notable exception is archiving documents, which must be done through a command-line utility directly on the server.

Users interact with the ViewZ front end, which integrates itself directly into an application, such as Microsoft Word

for Windows, using the host application's own script capabilities. The administrator can use the main ViewZ interface to define users and to customize the document profile even further. Application-specific versions of ViewZ are available for Ami Pro, Microsoft Excel, Word for Windows, and WordPerfect for Win-

dows; support for other applications is constantly under development. Front ends from other companies are available for at least five other applications, including the DOS versions of WordPerfect and Microsoft Word.

We tested ViewZ for Word for Windows, which integrates very well with the application. ViewZ loads automatically when you start Word and completely takes over the file find, retrieve, and save functions. The package displays additional dialog boxes representing the document's profile and uses a tree-like structure to track version control. It informs the user when a document is checked out and only lets the user create a copy of the document after displaying a warning that it may not be the latest version.

ViewZ completely controls document access when it's running, so users can't create documents outside the system. However, individual documents created on an external workstation can be imported into the system.

We were unable to test Mezzanine's full-text search engine because the current version of ViewZ only supports profile searches. The next version of this front end, Version 3.0, will support full-text searches. The profile searches, however were exceptionally fast.

FRONT-END FLAWS

Mezzanine's client/server architecture gives it a good deal of flexibility, but the server is only as effective as the front ends used to access it. In the case of ViewZ, this means that you are unable to access some of the underlying engine's capability. For example, this front end lacks reporting features. Although the reporting information was stored in the server,

in our tests we found we could only access portions of it through the available front ends.

Mezzanine has every feature you could want in a document management system. In fact, its power is overkill for all but the largest user site. Be prepared to invest a lot of time and effort into getting the most out of this system, particularly when it comes to importing existing documents. And be sure to choose your front end carefully.

PC DOCS Inc.

PC DOCS

BY JAMES KARNEY

Network administrators will love the control over files and access that PC DOCS, Version 4.1, provides; users may appreciate it without even realizing it's there. PC DOCS (\$495 per server; \$295 per user for full text, \$225 for profile searching only)

SUITABILITY TO TASK

PC DOCS

	POOR	FAIR	GOOD	EXCELLENT
Installation and enterprise conversion				
Document creation and access				
System maintenance and reporting				

has a mild-mannered facade, but don't let its seeming simplicity fool you: Underneath, there's a powerful document management engine that can track and control all of your file creation and editing, even over wide area networks. Its ease of use, strong file import capabilities (it was the only package in this review that successfully imported all 200,000 of our test documents), fast operation, and excellent network capabilities make this former Editors' Choice the one to beat again.

The range of features and enhancements in this version show a sensitivity to user demands. Shortcut keys follow a natural order in the menus, and documentation and training materials have been improved. Profiles can be joined to form groups of related documents within a library, allowing a user to cross-reference files related to a specific project or task. Version control allows 99 different versions of a file and up to an additional

FACT FILE

Mezzanine, Version 3.0a

Saros Corp., 10900 NE 8th St., 700 Plaza Center Bldg., Bellevue, WA 98004; 206-646-1066; fax: 206-462-0879

List price: Including ViewZ for Word for Windows. \$399 per user for 1 to 49 users; \$379 per user for 50 to 100 users; \$349 per user for 100 to 299 users; \$299 per user for 300 to 999 users; price negotiable for more than 1,000 users. Any single ViewZ version purchased alone: \$199 per user. Additional ViewZ versions: \$99 per user.

Server requirements: 386SX or better PC, 8MB RAM, 40MB hard disk space, OS/2 1.30.1

Workstation requirements: 286 or better, 2MB RAM, 1MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.x, Named Pipes support, EGA or better display.

In short: An extremely powerful and expensive document management system that may be overkill for mid-size businesses. This package offers users a lot of flexibility, but it is only as good as the front end that is used to access it.

ON READER SERVICE CARD

26 subversions of each of those.

The current release also fixes some complaints noted in our review of December 17, 1991. PC DOCS now offers an option to prevent users from overwriting original documents. If you turn this feature on, you must save a revision as a new version or subversion. Another new feature is the ability to rename and customize most of the labels and entry options for document profiles.

Two drawbacks may prompt some potential customers to consider other options: PC DOCS is limited to NetWare and Novell's Btrieve database, and it doesn't offer much support for applications other than WordPerfect. Those objections aside, PC DOCS handles its tasks remarkably well. If your organization uses Microsoft Windows, the soon-

to-be-released PC DOCS Open, which supports all Windows applications and several networks, may be a better solution. (for more information, see the sidebar "PC DOCS Open: The Next Step"). For DOS users, the updated Version 4.2 is due out soon.

Installing PC DOCS is an easy task:

Installing PC DOCS is easy: Load five disks and answer the resource allocation questions based on worksheets provided in the manual.

Load five disks and answer the resource allocation questions based on worksheets that are provided in the manual. If you are unfamiliar with information systems design, you might want to consider the services of an experienced VAR, but setting up the package involves few technical

challenges. The program reads and later monitors the accounts and groups shown in the NetWare Bindery, automatically adding them to the list of users. Based on privileges, users and groups can be



FACT FILE

PC DOCS, Version 4.1

PC DOCS Inc., 124 Marriott Dr., #203, Tallahassee, FL 32301; 800-933-3627, 904-942-3627; fax: 904-942-1517

List price: \$495 plus \$225 per workstation (\$295 for full-text option).

Server requirements: 5MB RAM, 1.5MB hard disk space per 1,000 documents, DOS 3.3 or later, NetWare 2.2 (3.11 recommended), Btrieve 5.15 VAP or NLM.

Workstation requirements: 286 or better, 640KB RAM (2MB recommended), 1MB hard disk space, DOS 3.3 or later (5.0 recommended), IPX 3.10, VGA display recommended.

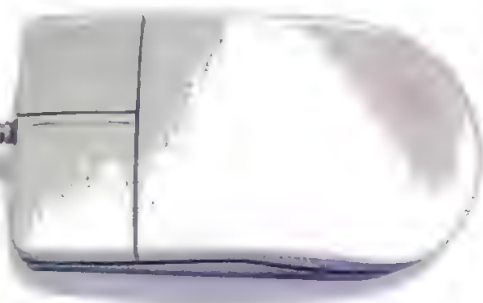
In short: PC DOCS couples outstanding features with speed and ease of use. If you need a full-powered package this should meet your needs, especially if your firm already uses WordPerfect. Its only limitation is that it will only run under NetWare. But for corporate-strength file management, PC DOCS is a well-conceived program that just keeps getting better and better.



ON READER SERVICE CARD

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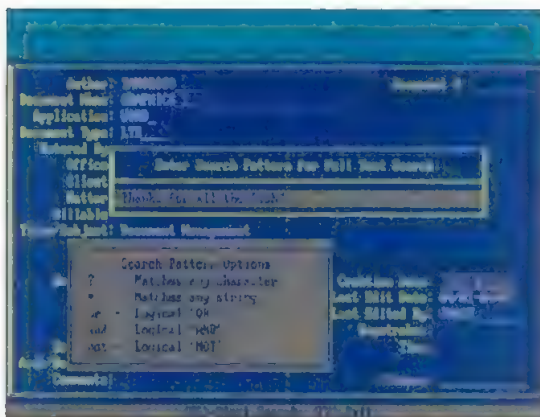
assigned or denied rights to a file directly from its profile screen.

COMMON DENOMINATOR

PC DOCS is designed around the premise that the user should handle document creation and retrieval, while the network administrator should control the location of files and access to them. The program tracks all file operations on the network; whenever you open, edit, print, or check out a file, PC DOCS keeps a record of the transaction.

Each time you create or revise a document, you must complete a profile, even if you launched the document outside of the file management system. The package gives you the option of filling out the profiles when you create documents, or of waiting until after a work session and completing them in groups. But you must create a profile for each document you create. We were unable to get around that requirement during testing, even by going through multiple DOS command shells.

The profile menu is very clear, with



PC DOCS offers several full-text search pattern options, including the ability to use wildcard and Boolean operators.

a template for commonly used formats (most of the blanks are already filled in). The close connection to WordPerfect is very evident here. Pressing the F5 key inside the word processor brings up the PC DOCS profile menu for file retrieval rather than the WordPerfect list function. PC DOCS also gives users control over both WordPerfect document work screens, to make performing cut-and-

paste operations easier. The close connection extends to function-key compatibility for the save, exit, and print commands for DrawPerfect, LetterPerfect, PlanPerfect, and WordPerfect. In offices that rely on those applications, even the average user will be able to efficiently use PC DOCS with little additional training.

As soon as the profile entry has been confirmed, PC DOCS adds the document to the index—so quickly that you have to look closely to see the status note on the bottom of the screen in order to be certain.

EASY TO FIND

To find a document, you can use the profile menu or a list of your 20 most recently used files. You can query by example and fill in an author, document name, or client, and you can include wildcard and Boolean operators. Other retrieval options include quick listings sorted by

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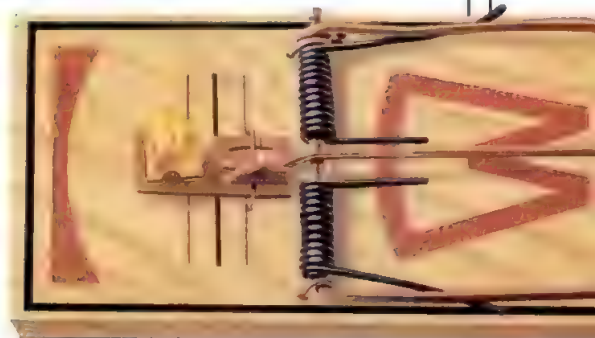
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All Express Notebooks Include:

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Built-in 9600 baud fax/2400 baud modem, both send/receive.

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Express 425ColorPlus

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► SUMMARY OF FEATURES

CONTINUES

Document Management Software

Products listed in alphabetical order



☒ = YES ☐ = NO	Keyfile Workgroup Edition	Mezzanine (with ViewZ)	PC DOCS	SoftSolutions for DOS / for Windows
Networking Support				
Systems supported	LAN Manager, LAN Server, Microsoft Windows for Workgroups, NetWare 2.x or 3.x, Pathworks, VINES 4.1 or later	3+Open, LAN Manager, LAN Server, NetWare, VINES	NetWare 2.2 or 3.11	NetWare, Pathworks, Unix NFS, any that supports DOS file sharing and locking
WANs supported	Through a message- handling service only	Any that supports Named Pipes	NetWare 2.2 or 3.11	DECnet, NetWare, TCP/IP
Database				
Search engine and profiles engine	Proprietary	Microsoft SQL Server 4.2	Btrieve	Proprietary
Full-text engine	Proprietary	Fulcrum	InfoLink	Proprietary
Indexing/Sorting				
Indexing by:				
Author	☒	☒	☒	☒
Category	☒	☐	☒	☒
Creation date	☒	☒	☒	☒
Date	☐	☒	☒	☒
Document number	☒	☒	☒	☒
Full text	☒	☒	☒	☒
Keywords	☒	☒	☒	(custom fields)
Schedule	☒	☒	☒	☒
Subject	☒	☒	☒	☒
User-defined category	☒	☐	☒	(custom fields)
Sorting by:				
Primary field	N/A	☒	☒	☒
Any field	☒	☐	☒	☒
Multiple fields	☐	☐	☒	☒
Searching				
Searches across networks	☒	☒	☒	☒
Transparent searches	☒	☒	☒	☒
Search types:				
Author	☒	☒	☒	☒
Client	☒	☒	☒	☒
Combined profile-text search	☒	☒	☒	☒
Creation date	☒	☒	☒	☒
Date range	☒	☒	☒	☒
Document number	☒	☒	☒	☒
Full-text	☒	☒	☒	☒
Fuzzy logic	☐	☐	☐	☐
Keywords	☒	☒	☒	☒
Multiple simultaneous users	☒	☒	☒	☒
Nested search	☒	☒	☒	☒
Pattern matching	☐	☒	☒	☒
Phonetic search	☐	☐	☐	☒
Query by example	☒	☒	☒	☐
Subject	☒	☒	☒	☒
User-defined category	☒	☒	☒	☒
Wildcard	☒	☒	☒	☒

N/A— Not applicable: This product does not use traditional fields

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ZXPortable Dual Scan Color

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- 86-key full-travel keyboard with inverted "T" cursor control
- Nickel metal-hydrate battery provides up to 2 hours of power with Power Management enabled
- True 8.5" x 11" size; 6.4 lbs.
- MS-DOS 6.0 and Windows™ 3.1
- Logitech TrackMan Portable mouse
- Fabric carrying case
- Free \$395.00 value PackRat contact/personal information manager software

\$2499

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► SUMMARY OF FEATURES

CONTINUED

Products listed in alphabetical order

■ = YES □ = NO



	Keyfile Workgroup Edition	Mezzanine (with ViewZ)	PC DOCS	SoftSolutions for DOS / for Windows
Searching (continued)				
Search operators:				
AND	■	■	■	■
OR	■	■	■	■
Exclusive OR	□	□	■	□
NOT	■	■	■	■
Greater than/Less than	■ (date field only)	■ (date field only)	■	■
Not equal	□	□	■	■
Maximum operators in search expression	1	2	Unlimited	Unlimited
Document Management				
Automatic file naming	■	■	■	■
Assigns DOS filenames	□	□	■	■
Can make documents private	■	■	■	■
Can shadow documents locally	■	■	■	□
Can relocate documents:				
To different directories	□	■	■	■
To different servers	■	■	■	■
Version tracking:				
Tracks previous versions	■	■	■	■
Sets version number	■	■	□	■
Tracks subversions	■	■	■	□
Overwrites original version	□	■	■	■
Removes references to original	■	■	■	■
Removes original version from system	■	■	■	■
Document logging:				
Checkout	□	■	■	■
Copy	□	■	■	■
Retrieve without edit	□	■	■	■
View	□	□	■	■
Tells users/administrator who has a document open	■ ■	■ ■	■ ■	■ ■
Document Retrieval				
User can view documents without entering application	■	□	■	■
Viewers directly supported:				
ASCII files	■	■	■	■
Ami Pro	■	■	□	■ (Windows version)
Lotus 1-2-3	■	■	□	■
Lotus 1-2-3 for Windows	■	■	□	■
Microsoft Excel	■	■	□	■ (Windows version)
Microsoft Word for Windows	■	■	□	■ (Windows version)
Quattro Pro	□	□	□	□
WordPerfect	■	■	■	■
Viewers for bitmapped graphics files	■	■	□	□
Viewers for vector graphics files	□	□	□	□
Supports third-party file viewers	■	■	■	■
Data Import and Export				
Bulk imports	■	■	■	■
Imports into profile fields	■	■	■	■

► SUMMARY OF FEATURES

CONTINUES

Products listed in alphabetical order

■ = YES □ = NO



	Keyfile Workgroup Edition	Mezzanine (with ViewZ)	PC DOCS	SoftSolutions for DOS / for Windows
Data Import and Export (continued)				
Import formats				
ASCII	■	■	■	■
DBF	■	■	□	■
Microsoft Word for Windows	■	■	□	■
WK?	■	■	□	■
WordPerfect 5.1 and 5.2	■	■	■	■
XLS	■	■	□	■
Reporting				
Customizes reports	□	■	■	■
Exports reports	□	■	■	■
Report fields				
Files archived	■	(requires user programming)	■	■
Files deleted	□	■	■	■
File accesses	□	■	■	■
User entries into system	□	■	■	□
Document storage map	■	■	■	□
System configuration	□	■	□	■
User configuration	■	■	■	■
Configuration changes	□	□	□	■
Automatic document purging				
By author	□	■	■	■
By client	□	□	■	■
By date	■	■	■	■
By subject	□	■	■	■
Archiving/Dearchiving				
Automatic archiving				
To Bernoulli Box	□	□	■	■
To optical drive	■	□	■	■
To other servers	□	■	■	■
To tape	□	■	■	■
Select documents to archive by				
Author	■	■	■	■
Category	■	■	■	■
Client	■	□	■	■
Creation date	■	■	■	■
Document number	■	■	■	■
DOS filename	■	□	■	■
Keywords	■	■	■	■
Last edit date	■	■	■	■
User-defined date	■	■	■	■
User-defined fields	■	■	■	■
Administration and Security				
Uses NetWare security	□	■	■	■
Uses own security	■	■	■	■
User without rights may view profile	■	□	■	□
Encrypts documents	■	□	□	□
User can assign access rights				
By user	■	■	■	■
By group	■	■	■	□
By directory	□	■	■	□

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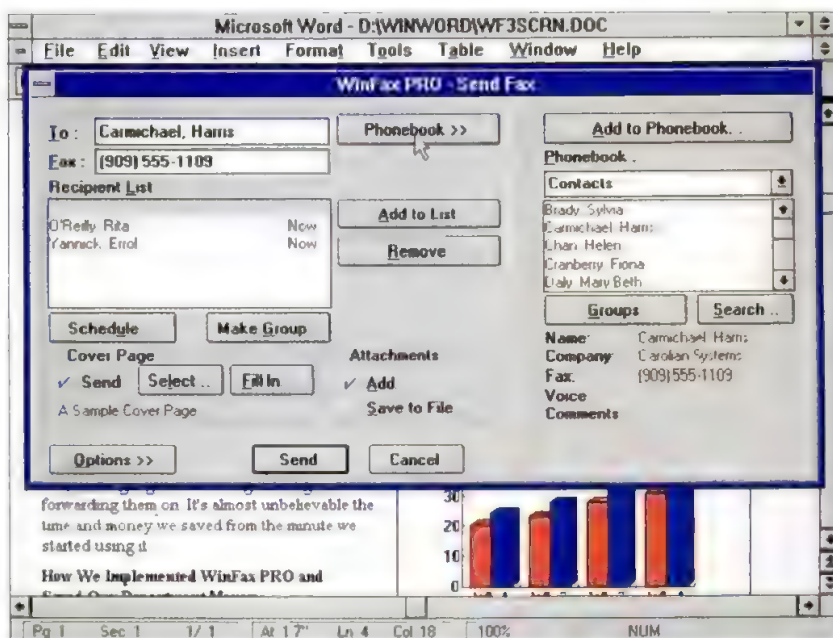
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WinFax PRO 2.0



WinFax PRO 3.0



WinFax PRO 2.0



► SUMMARY OF FEATURES

ENDS

Products listed in alphabetical order

■ = YES □ = NO



	Keyfile Workgroup Edition	Mezzanine (with ViewZ)	PC DOCS	SoftSolutions for DOS / for Windows
Administration and Security (continued)				
By document/document category	■ ■	■ ■	■ ■	■ ■
System access:				
Keeps access log	■	■	■	□
Keeps failed-password log	■	□	■	□
User restrictions:				
Edit	■	■	■	■
No access	■	■	■	■
Read only	■	■	■	■
Read filenames only	■	■	■	□
Group restrictions:				
Edit	■	■	■	□
No access	■	■	■	■
Read only	■	■	■	□
Read filenames only	■	■	■	□
Training				
Training offered by vendor	■	■	■	■
On-line help	■	■	■	■
Context-sensitive help	■	■	■	■
Technical Support				
Toll-free technical support	□	□	□	□
Technical support hours (eastern time)	9:00-6:00	8:00-8:00	8:00 A.M.-9:00 P.M.	9:00-8:00
BBS	Company-run	Company-run	Company-run	Company-run

common criteria, adding full text (if you have purchased that option), and phrase/proximity searching.

While the program may not keep up with some dedicated full-text engines, we had no trouble executing complex queries across a wide area network using a mix of search techniques. With its close ties to Novell networks, PC DOCS shines in a wide-area situation; it automatically attached a remote server as needed during our test searches.

HERE, THERE, OR TO GO

PC DOCS can respond to searches so quickly because it uses a double database storage approach and keeps network traffic to a minimum. All information contained in the document profiles, including keywords, is stored in Novell's Btrieve relational database. Full-text

indexes are stored in a separate engine (available for an additional fee). We managed to get hits on our full-text queries in about one second, with tens of thousands of files in the database—while batch indexing of 200,000 documents was taking place on two workstations.

PC DOCS's reporting tools offer the savvy administrator features for improving network productivity and cost accounting procedures.

You don't have to worry about where a file is stored; all you need are access rights and an open network gateway. Although users can specify a library or directory when asking for a file, it's not necessary. A search will automatically track through every library on any available system, local or remote. To minimize network traffic, users can keep their own files on local drives.

With the increasing use of notebook and laptop PCs, not to mention at-home desktop systems, it's important to be able

to track files that have been taken offline. The Check-Out feature logs the names of users who have removed files and when the files are due back. All regular revision controls can be applied when the file is returned.

ADMINISTRATIVE MATTERS

PC DOCS does more than just fancy file management. Its reporting tools offer the savvy administrator a variety of features for improving network productivity and cost accounting procedures. The system tracks every event by individual users and groups, including editing, viewing, printing, time spent, and dates of occurrence. Reports can show the clients for whom tasks were performed, with subtotals. In fact, PC DOCS monitors users so closely that some may feel as though Big Brother is looking over their shoulders. Administrators can use these reports to keep track of billable time and levels of effort, and can export this information to an accounting program or spreadsheet. A network supervisor can use the same reports to decide how to relocate files to

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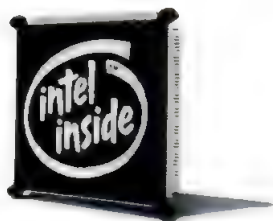
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Document Management

reduce traffic, how to relocate printers, and when to obtain additional hardware.

PC DOCS is a well-conceived program that keeps getting better. The 4.2 release was not available for an early look, but company sources indicated that it will include increased support for template creation, optional storage, redlining across libraries, and setting profile defaults by the current user or group. If you want corporate-strength file management without putting up with mainframe maintenance, PC DOCS comes close to providing an out-of-the-box solution.

SoftSolutions Technology Corp.

SoftSolutions for DOS

SoftSolutions for Windows

BY JOE SALEMI

Both SoftSolutions 3.0a for Windows and 3.0 for DOS from SoftSolutions Technology Corp. are traditional document managers: The user interacts directly with the programs, which launch the appropriate applications. The main advantages of SoftSolutions are the ability to work on both DOS- and Unix-based networks and the availability of add-on modules that

SUITABILITY TO TASK

SoftSolutions

	POOR	FAIR	GOOD	EXCELLENT
Installation and enterprise conversion	●	●	●	○
Document creation and access	●	●	●	○
System maintenance and reporting	●	●	●	●

extend SoftSolutions' search capabilities.

Both the DOS and Windows versions can access the same server. The price for either version is reasonable: The initial package with the server software and one user interface costs \$495, and each additional user package costs \$295.

INSTALLATION AND SETUP

The installation process is completely automated through a setup utility native to the client workstation's operating environment. SoftSolutions' server software can be installed on a standalone system or on a network server where it can be used by any number of users. It has direct support for NetWare, Pathworks,

and any LAN that supports DOS file sharing and locking. It also supports a number of Unix servers through an additional \$2,995 server module.

SoftSolutions also has a network loadable module (NLM) available (\$1,995 per file server) that speeds up file accesses on a NetWare server. We found that the NLM accelerated document importing and indexing by about 50 percent.

After the main software is installed, the DOS version of SoftSolutions installs some additional utilities through a batch file-driven screen that is not well documented or easy to decipher. SoftSolutions is working on an update to improve the installation process.

An initial copy of the client software

SoftSolutions' server

software can be installed on a standalone system or on a network server.

is installed at the same time as the main software. Once the DOS client is installed, any number of licensed users can use the same copy on the client workstation. The Windows version requires an additional step: The administrator has to run a workstation setup on every client. This setup copies the necessary DLLs to the workstation and makes the appropriate changes to the WIN.INI file. You'll also have to take some additional and undocumented steps if you're going to run both DOS and Windows clients.

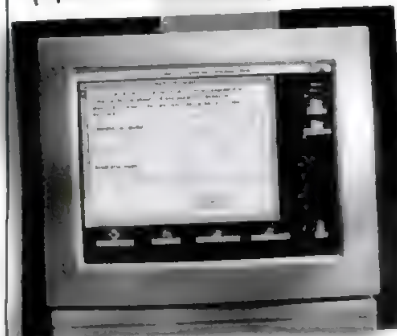
Once you've finished installing, you're ready to start importing. You can import documents either individually or through a mass-import menu choice. SoftSolutions can automatically import WordPerfect document profiles into its own proprietary profile database. Otherwise, it uses the default profile provided on the mass-import screen. Profiles are indexed automatically as they're added and can be searched immediately. Full-text indexing, however, has to be explicitly started by the administrator. The documents waiting to be indexed are held in a queue and can't be searched until the indexing is done. They can be indexed overnight,

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SoftSolutions 3.0 for DOS

SoftSolutions 3.0a for Windows

SoftSolutions Technology Corp., ParkView Plaza, 625 South State St., Orem, UT 84058; 801-226-6000; fax: 801-224-0920

List price: \$495 plus \$295 per workstation, for either DOS or Microsoft Windows version

Server requirements: Any Novell network, 7MB hard disk space

Workstation requirements: DOS version: 8088-based PC or better, 640KB RAM, DOS 3.0 or later. Windows version: 386SX-based PC or better, 2MB RAM, Microsoft Windows 3.x.

In short: Reasonably priced choices for small to mid-size businesses that need to track documents on both DOS and Unix systems



but to get the best performance you must dedicate a workstation to indexing new documents. SoftSolutions' importing and indexing aren't very fast, and the programs were only able to import a total of about 28,000 of our 200,000 test documents during the time allowed.

ACCESSING DOCUMENTS

Both the DOS and Windows versions of the package share a common interface. When you start the system, you're presented with a profile search screen and a number of menu choices to find existing documents, view them in read-only mode, and edit them. Other menu items let you create new documents or import external documents.

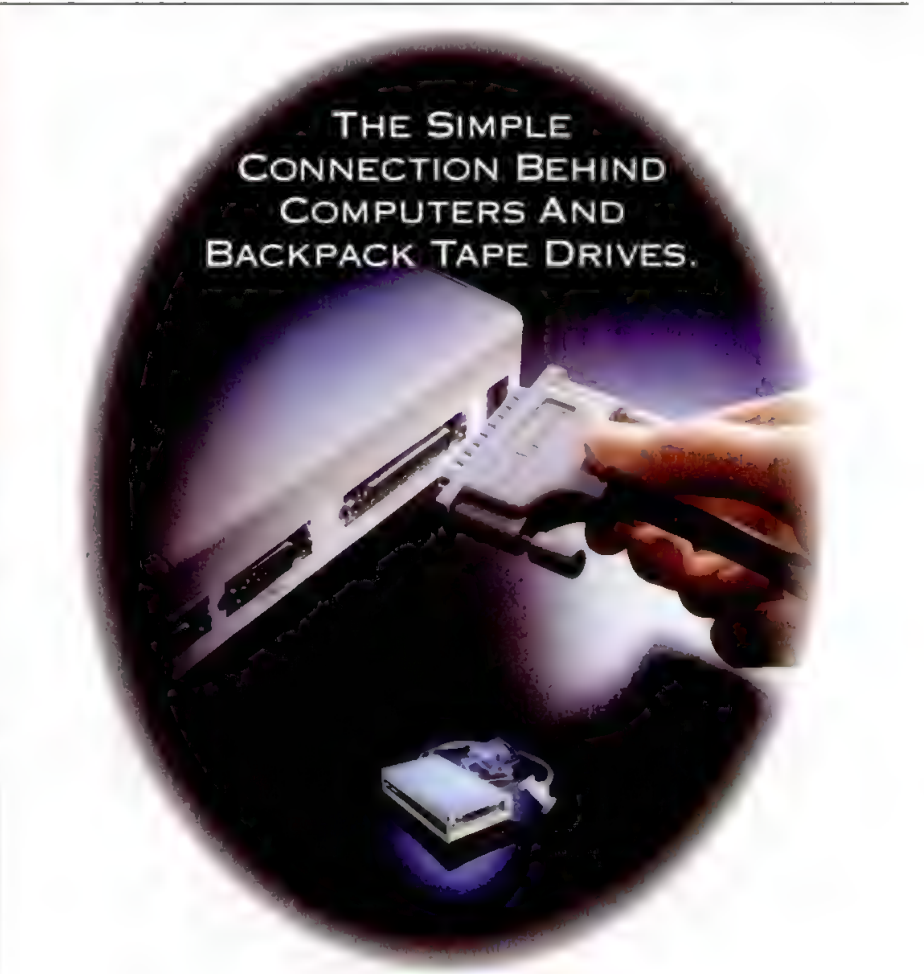
The Windows version automatically hooks into the applications specified during installation but otherwise takes little advantage of the Windows interface. The administrator has to set up each individual application in the DOS version through a complicated process of specifying the SoftSolutions name for the document, the command line for the document, and a number of specific command-line parameters that let SoftSolutions correctly interface with the application.

Before running SoftSolutions, DOS WordPerfect users must load an included TSR utility that replaces WordPerfect's

regular file menus with a menu that is appropriate for the document manager. If the TSR isn't there, SoftSolutions will launch WordPerfect but won't know about any documents the user creates. The setup works well but places additional overhead on the client. In our testing, even a 486 workstation paused noticeably as SoftSolutions switched back and forth between its own profile

screens and WordPerfect. SoftSolutions recommends having at least 512K of EMS memory on the workstation to speed the task switching.

The Windows version is smart enough to know whether the user is running the Windows or the DOS version of an application that comes in both flavors, and is smart enough to load the appropriate version when the user chooses a docu-



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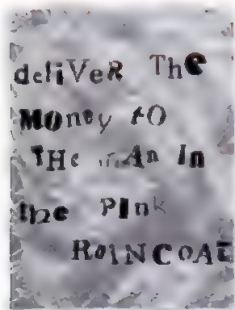
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GRAPHICS

Document Management

ment. Overall, though, the Windows version has an unfinished feel to it, and we encountered a few problems with it during our testing. SoftSolutions supposedly sets up the Windows applications that are installed on the workstation to interface directly with the document manager itself, but the link doesn't always work properly. We had to change the command-line parameters manually in order to get SoftSolutions to launch Excel correctly and load the worksheet that was specified in the profile.

SEARCHING AND SECURITY

Documents can be searched on the profile items, through a full-text search screen, or by using a combination of both techniques. The profile can have up to 20 custom fields in addition to the mandatory ones. The administrator can choose whether the custom fields will take automatic or user-entered values, and whether or not the field can be included as part of a search. Document versions are tracked through 999 version numbers, and the user is warned if the version he or she retrieves isn't the most current.

The administrator can create customized reports that detail the structure of the system, which documents were created or modified by which users, and the current status of all documents in the system. Reports can also be used to archive or delete documents based on the search criteria entered in the report definition. Users can retrieve archived documents without administrator intervention.

Document security is still a problem with SoftSolutions. WordPerfect users can create documents outside the system if the

TSR isn't loaded, and DOS and Windows users can directly access documents outside the system if they know where the documents are located and have access to the shared directory. In our testing, we were also able to load Windows applications directly without going through the SoftSolutions management screen and then work on documents and spreadsheets that the system never knew about.

Two additional modules are available to extend the program. Intelligent Search (\$195) adds numeric, logical, and fuzzy

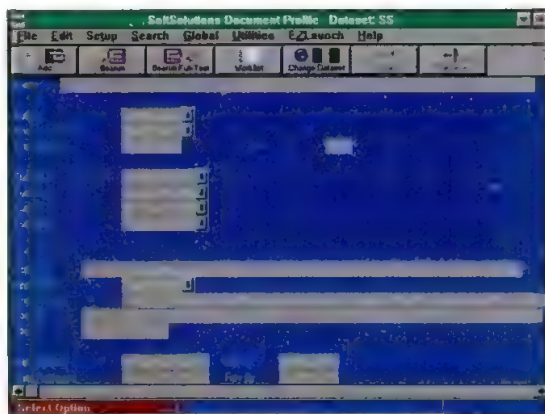
*In SoftSolutions,
documents can be searched
on the profile items,
through a full-text search
screen, or both.*

search parameters, while the Image Manager (\$125) tracks scanned documents stored in FAX Group 3 or 4, .PCX, and TIFF formats. A software developers kit (\$895) is also available for those who want to write their own interface to the SoftSolutions search engines.

SoftSolutions Technology Corp. provides free support for the life of the product during standard business hours; expanded 24-hour, 7-day support is available for a fee based on the size of your site. User and administrator training is also available at SoftSolutions headquarters or at your site.

SoftSolutions is a capable document

management system for small to midsize businesses, provided you keep its limitations in mind and don't require strict document security. It's particularly well-suited for tracking documents on a mix of DOS- and Unix-based servers. It's easy to install, but be prepared to spend some time integrating it with your existing applications. The DOS version is currently the better choice, particularly for WordPerfect users. Windows users may want to wait for the next version. □



SoftSolutions' Windows interface replaces the pop-up menus used in DOS with pull-down menus.

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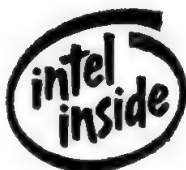
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FAST AND FLEXIBLE

SCSI Technology Grows Up



Hard-to-configure setups may have given SCSI a bad rap, but developments promise to make its lure hard to resist.

Speed, simplicity, and free expansion slots are SCSI's siren song. The small computer system interface concept is simple: A single card will connect as many as seven devices to your computer and promise data-throughput rates of up to 40 MBps (with the new Fast-Wide SCSI-2 protocol). You can mix hard disks, CD-ROM drives, tape backup units, printers, scanners—almost anything. Adding a new device

is allegedly as simple as plugging it in on the end of the chain.

Several facts make SCSI's promise of high performance and slot-saving abilities very desirable. SCSI is a natural for networks and for multitasking, multithreading operating systems such as OS/2, Unix, and Microsoft Windows NT because these environments can take advantage of SCSI's ability to manage large storage devices and to grant access to several devices at the same

by James Karney

H I G H L I G H T S

SCSI Technology

THE SMALL COMPUTER system interface (SCSI) is a full-fledged, bidirectional, intelligent I/O subsystem specification. A single SCSI host adapter can connect up to seven intelligent SCSI devices, including hard disks, scanners, and CD-ROM drives.

THE NEW SCSI-2 draft spec, which should be ratified by the time you read this, specifies high-performance protocols. Fast SCSI offers throughput of up to 10 MBps; Fast-Wide SCSI provides up to 40-MBps transfer rates over a 32-bit path.

COMPARED WITH IDE DISKS, SCSI hard disks offer more capacity (3GB, versus around 1GB for IDE), so they can better handle the storage-hungry needs of multimedia applications such as sound and full-motion video. SCSI, especially Fast and Wide SCSI, also

provides greater throughput than IDE (which provides around 3 or 4 MBps). But expect to pay a premium for SCSI: A SCSI hard disk can cost about \$100 more than a comparably sized IDE hard disk.

MULTITASKING, multithreaded operating systems, such as Microsoft Windows NT and Unix, can use SCSI's abilities to grant access to several devices at once and to queue commands.

A UNIVERSAL DRIVER, defined by the competing ASPI and CAM standards, lets the SCSI host adapter and operating system communicate; separate device driver modules allow for communications between the host adapter and each peripheral. Future Domain's ASPI-to-CAM converter, for example, allows you to use ASPI devices with a CAM controller.

me. SCSI's ability to chain several devices to one card makes a lot of sense for device-intensive multimedia applications, which can require an extensive array of peripherals from CD-ROM drives to large hard disks and rewritable optical drives.

And only SCSI hard disks can have the capacity that you will need for serious multimedia use: Even $\frac{1}{16}$ of a screen of compressed, adequate-quality, 60-second motion video can take up about 15MB of disk space, and a stereo 16-bit, 44.1-kHz WAV sound file occupies over 10MB for every minute of sound. Hard disks conforming to the new SCSI-2 draft specification are typically available in sizes up to 3GB; compare that with Integrated Drive Electronics (IDE) disks, which have just begun to arrive in 1GB capacities, and with enhanced small device interface (ESDI) disks, a nearly defunct technology that also topped out at a little over 1GB in most instances. SCSI's high throughput also makes SCSI hard disks the recommended choice for all Digital Video Interactive (DVI) capture boards.

In short, SCSI is soon going to be *the*

way power users hook up peripherals to their PCs. It's already the choice for most networks, particularly if they achieve fault tolerance through Redundant Array of Inexpensive Disks (RAID) subsystems. So why hasn't everyone jumped onto the SCSI bandwagon yet? Because until recently, SCSI didn't live up to its promise of ease of use. Today, SCSI is simpler to use than it once was; soon, it may even be considered easy. The interface with the ugly name is growing up into a thing of beauty.

UNDERSTANDING SCSI

In the early days, poor integration with DOS and incompatibility among products made installing SCSI devices on PCs difficult at best. It was almost impossible to get two different devices to work with a single SCSI adapter, and the task usually resulted in increased cost and frustration. Early SCSI hard disks based on the original American National Standards Institute (ANSI) standard, now commonly known

as SCSI-1, were limited to a maximum throughput of 5 MBps. They originally faced stiff competition from ESDI hard disks, which offered comparable storage capacity (around 1GB) and far fewer compatibility headaches, if a little less maximum throughput (around 2.4 MBps).

But ESDI's inability to control any devices except hard disks—coupled with SCSI-2's promise of increased throughput and better compatibility—has all but resulted in ESDI's demise. New SCSI-2 devices are among the fastest around—Fast SCSI (a protocol within the SCSI-2 draft specification) has a maximum 10-MBps delivery that easily surpasses the 3-MBps to 4-MBps throughput of today's IDE hard disks—while improved adapters and software ease complex installations. Our testing showed that while SCSI is not yet hassle-free, the struggles you still may face are outweighed by the potential performance gains.

Of course, you'll pay a premium for SCSI's features and performance—a SCSI-1 hard disk usually costs about \$100 to \$150 more than a comparably sized IDE hard disk, and a Fast SCSI hard disk generally costs about \$200 more. (For more on performance and features differences between IDE and SCSI technologies, watch this section in forthcoming issues.)

For operation, SCSI demands understanding of its idiosyncracies because it is not like other PC interfaces: No PC operating system currently provides seamless support for SCSI (as DOS and OS/2 do for IDE and ESDI disks), so that capability has to be added by loading drivers. But SCSI goes beyond interfaces like these because it is more than just another way to hook up a hard disk: it is a full-fledged, bidirectional, intelligent, I/O subsystem specification.

The SCSI expansion card, or host adapter, actually runs a self-contained expansion bus. Data is transferred directly among all units, including the host adapter, which handles all communications with the host computer.

Each device is intelligent and has its own internal controller, which can send, re-

Our Contributors: JAMES KARNEY is a frequent contributor to *PC Magazine*. JENNIFER ZAINO was the associate editor in charge of this story, and MICHAEL J. ZULICH was the project leader.

ceive, and execute SCSI commands through the host adapter. A device can handle data internally almost any way it wants—as long as it communicates to the adapter using SCSI commands and formats. This gives SCSI its flexibility (though there is slight overhead in handling the instructions): A new device or transfer method that was not even dreamed of when the SCSI standard was written can be incorporated if the host adapter can control it with legal SCSI commands.

Everything on the chain, including the adapter, has a unique ID number ranging from 0 to 7, allowing data to be moved, independent of the host computer, to the addressee. You can place more than one SCSI host adapter in a PC, each with a maximum of seven devices. Each adapter can run as a separate bus, or you can attach one or more host adapters as slaves (with their own devices) to a primary host adapter, nesting the chains. The latter approach increases the number of possible devices that can be controlled via a single slot in the PC because you can house the secondary host adapters in an expansion chassis. That feature is possible today only with fancy custom software.

A flat ribbon cable connects internal SCSI devices to the bus, and external units are daisy-chained from a port on the back of the host adapter. Each end of the bus must be terminated to signify the end of the chain (the SCSI adapter will usually be one end of the chain, but if you have internal and external SCSI devices, the SCSI host adapter generally should not be terminated). A SCSI terminator is an electrical resistor (either internal or external) that ensures reliable communications by preventing excess signal noise on the line.

SCSI'S REWARDS...

For this article, we readied two Micronics Gemini 486 VL-Bus 486/DX2 66-MHz machines with 16MB of RAM and a 256K external cache each. One system coupled an Industry Standard Architecture (ISA) expansion bus with two VESA (Video Electronics Standards Association) VL-

Bus slots; the other provided an Extended Industry Standard Architecture (EISA) expansion bus coupled with a VL-Bus. The former system was loaded with a beta version of OS/2 2.1; the latter with Unix, specifically, Santa Cruz Operation's Open Desktop 2.0 (SCO ODT). Both ran MS-DOS 5.0 and Microsoft Windows, Version 3.1. During testing, we added on (and removed) a variety of IDE, ESDI, and SCSI peripherals to each, mixed and matched equipment, swapped several host adapters, and loaded new drivers for the SCSI configurations.

The final outcome: When the systems were loaded solely with SCSI-2 devices, they flew! While it is impossible to offer benchmark comparisons with such a mix of hardware and drivers, we saw a defi-

that some of the advantages of the configuration in comparison. ESDI configuration may be faster than the use of a VL-Bus controller, but it is able to open complex graphics files stored on the SCSI hard disk in less time it took to open those on the IDE hard disk, and only a quarter of the time it took from the IDE disk.

...AND THE CHALLENGE BEHIND THEM

Configuring a SCSI system with several devices should be a snap. In a best case scenario, there would be just one card (and therefore relatively few jumpers) and only one I/O and port address to worry about. On minis, Macs, and many Unix workstations, SCSI support is built directly into the operating system kernel and hardware, so integration is not much of a problem. Third-party products' drivers have to conform to both the SCSI standard and that computer's system requirements.

But the PC is different. Many early SCSI-1 peripherals were designed to work with one or perhaps a few specific host adapters, but were not likely to work with any other adapters because no one—not the device manufacturer or the host adapter vendor, and certainly not DOS—supplied the appropriate drivers. (Today, vendor-specific approaches are less common.)

The driver problem has its roots in the development of the original ANSI SCSI-1 standard that was adopted in 1986. This standard called for a maximum 5-MBps throughput over an 8-bit parallel data path on the SCSI bus (even though your SCSI-1 or draft SCSI-2 adapter may have a 16-bit slot connection, it utilizes only an 8-bit address space), but otherwise its requirements were vague. As long as a vendor incorporated some of the SCSI commands, a product could be called SCSI-compliant (the exact number and specific required commands were an issue of debate). Since SCSI supports all kinds of devices, a specific driver is needed to handle communications between the host adapter and each device. All this opened up the floodgates

Setting up a SCSI system with several devices should be a snap. In a best case scenario, there would be just one card and one I/O and port address to worry about.

nite improvement for standard functions in the SCSI-2 configurations. For example, on our final SCSI-only ISA/VL-Bus and EISA/VL-Bus installations, we were able to load Windows equipped with 160 TrueType fonts and two Windows TSRs from a Conner Agean Series 30540 Fast SCSI 545MB hard disk (available for about \$840 from resellers) controlled by a Fast SCSI \$325 UltraStor Ultra 34F VL-Bus SCSI Controller (with a 128K read-ahead buffer) in a mere 7 seconds. The same operation took 15 seconds when loading from a Western Digital Caviar AC2420 425MB IDE hard disk (about \$575 on the street) using a local-bus controller, and 35 seconds when loading from a Maxtor XT-8760E 670-MB ESDI hard disk controlled by a Western Digital 1009SE ESDI ISA controller (no longer in production) on both the ISA/VL-Bus and EISA VL-Bus test-beds. (When comparing these differences, remember

pages of the SCSI
comparison with the
attributed to
graphics files
on half the
the ESDI
time

forma-
for CAM
the host adapter
g system communi-
other.

current SCSI bus can have up to eight devices attached to it, including the host adapter. Device module drivers are required in order to connect each piece of hardware on the SCSI chain to the operating system; the device modules allow the peripherals to communicate with the host adapter.

(Exceptions to this are hard disks with capacities that are under 1GB—if the SCSI host adapter contains a BIOS INT 13h replacement in its boot ROM for hard disks assigned to SCSI IDs 0 and 1, no special drivers are required because the disks are controlled by the substitute BIOS software in the boot ROM.)

for a tidal wave of driver and host adapter incompatibilities that would keep SCSI from fulfilling one of its main promises—that one adapter can control up to seven peripheral devices of all kinds.

One of the few instances in which you won't have to confront driver incompatibility issues is in adding hard disks to your SCSI system. If the SCSI host adapter contains a BIOS INT 13h replacement in its boot ROM for hard disks assigned to SCSI IDs 0 and 1, no special drivers are required because the disks are controlled by the substitute BIOS software in the boot ROM. (Hard disks with capacities over 1GB are an exception.)

SCSI-2: RENEWED PROMISES

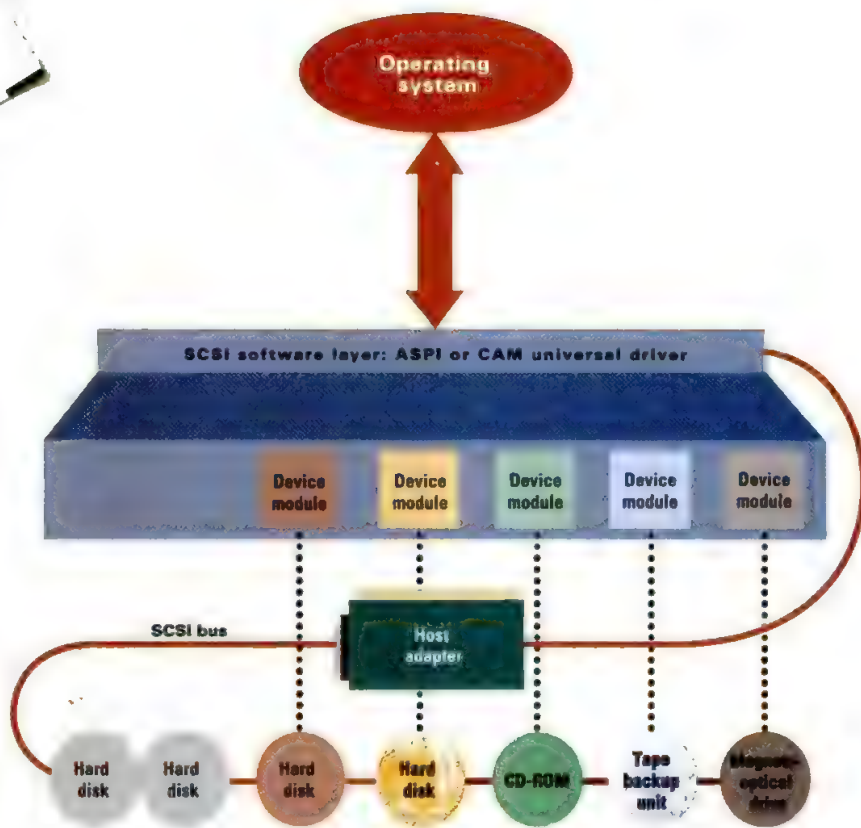
Unlike bad movies, SCSI's sequels get better. SCSI-2 has been in the works for several years and should be finalized by the time you read this, fixing a lot of the compatibility problems. In SCSI-2, the tighter command language leaves less

room for host adapter approaches that support only vendor-specific devices. The authors also added new command extensions that leave the door open to more specific support for new devices in the future: for instance, standardizing some commands that are common to a type of device—such as the retention tape command for a tape drive—so that the commands can be written into firmware instead of implemented in specific drivers.

And SCSI-2 authors didn't forget speed. Conformity to SCSI-2's *Fast*, *Wide*, and *Fast-Wide* protocols can provide outstanding performance. Fast SCSI is twice as fast as the original specification, with a maximum transfer rate of up to 10 MBps over an 8- or 16-bit data path (in practice, achieving the maximum transfer rate is more likely over a 16-bit path). Wide SCSI extends the SCSI data path to either 16 or 32 bits and can be coupled with Fast SCSI. It also allows

throughputs of 20 MBps over a 16- or 32-bit path. Fast-Wide SCSI provides 40-MBps transfer over a 32-bit path or 20MB over a 16-bit path. Of course, you'll need the right hardware to support Fast, Wide, and Fast-Wide SCSI before you see the performance gains. For instance, to access the full 32-bit expanded bandwidth available through Wide and Fast-Wide SCSI, you'll need either an EISA, Micro Channel architecture (MCA), or local-bus PC.

In testing Fast SCSI using the VL/ISA-bus system equipped with the Fast SCSI UltraStor Ultra 34F VL-Bus SCSI Controller and two Fast SCSI hard disks (the 560MB Micropolis Model 2105, which sells for around \$900 through dealers, and the Conner Agean Series 30540), operations on each disk ran about twice as fast as with the ESDI Maxtor disk and Western Digital ISA controller. Problems unrelated to the SCSI interface with some early edition Fast-Wide SCSI prod-



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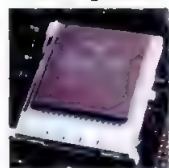
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Q. I want incredible speed. What should I look for?

A. For high-speed video that's upgradable with industry-standard graphic adapters, *you want a system that has VESA-standard local bus slots.* As we mentioned above, ZEOS gives you two of them. Our standard super-fast local bus SVGA card includes Windows acceleration, and if you want the video performance that PC Magazine said "blew all competitors away," choose our optional Viper video card. And, because you're getting the VESA standard, you won't get stuck with some proprietary architecture that's obsolete in 6 months. Demand VESA standard with your system!

And for data transfer that's over twice as fast, get *local bus IDE*. It's the same fast local bus technology applied to the built-in IDE drive

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Dell 466 DX/2	7.44	
Gateway 2000 40X2-66 V	21.18	
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ZEOS 486DX2-66 with our optional Viper video card!	42.64	

controller. ZEOS gives you performance *up to 225% that of ordinary IDE systems!*

Q. What's so important about SCSI? And Flash BIOS?



A. If you want to add high-performance CD-ROM drives and tape backups later, you need SCSI. ZEOS can add an extremely inexpensive (only \$49!) yet very high-performance SCSI option to your system without using an expansion slot. So you can run any SCSI options you desire—now or later.

Since optimum Pentium OverDrive upgrades require changing the BIOS, we include FLASH ROM technology—so you can easily upgrade the BIOS through a diskette or modem.

Q. How do I know I'm getting a high-quality system?

A. Look for a *high-quality motherboard.* ZEOS designs its own motherboard. Other vendors offer their "motherboard du jour," changing boards every time they find a

cheaper supplier. By controlling the manufacture of this key component, ZEOS guarantees you'll get full use of your PC far into the future.

Look for *quality components.*

Such as thick, strong cases with reinforced steel. SVGA monitors with .28mm dot pitch that are non-interlaced all the way up to 1024x768 resolution. ZEOS gives you all of this—and more.

You want a system that can handle the speed that you demand. Today's high-performance CPUs can quickly turn into a space heater with a keyboard. Not with ZEOS. We ensure your system's long life with a few important extras: *a high-capacity power supply with built-in surge suppression, and twin cooling fans.* Because the cooler your system runs, the longer it will last.



Q. What other things should I look for when I buy a system?

A. First, UL Listing.

Make sure it's on the entire system, not just the power supply. It means your system has passed rigorous tests for safety and we think that it says something about quality, too.

Second, check out the software. Get more than just simple starter software with your system. Most ZEOS packages come with *everything you need* to get started: your choice between *two* spreadsheet

SCSI Technology

ucts we had made it impossible for us to complete testing them in time for this review. But you can find several 16-bit Fast-Wide SCSI hard disks and controllers, including the new \$695 UltraStor Ultra 24FW EISA Fast/Wide SCSI Controller and \$799 BusLogic BT-757S host adapters, plus hard disks from Seagate Technology, Hewlett-Packard Co., and Micropolis. Wide SCSI's 20-MBps and Fast-Wide SCSI's 40-MBps potential will push more players to provide devices and controllers, albeit at premium prices. Expect to pay more than twice the price of a comparable-capacity IDE unit for Fast-Wide SCSI hard disks, for example.

With the right drivers, adapter, and combination of cables, you will be able to mix SCSI-1, SCSI-2, Fast SCSI, Wide SCSI, and Fast-Wide SCSI peripherals on the same chain without fear of backward-compatibility problems. Original SCSI-1 devices used a 25-pin connector that looked like either an RS-232 adapter or a large Centronics printer connector. SCSI-2 and Fast SCSI use 50-pin connectors. Most of the added pins provide grounding; the others are currently unused. Wide SCSI today uses a 68-pin P-connector that won't be standardized until the SCSI-3 specification gets off the ground. The extra positions on 68-pin P-connectors provide extra bandwidth for the wider bus.

Cables that offer 25-pin to 50-pin connections are available, but there is not yet a uniform way to mix 68-pin and 50-pin connectors on a chain. BusLogic offers 50- and 68-pin internal connectors with just a 68-pin external connector on its BT-757S and BT-757D adapters. You can link the 50-pin connector to external devices, but it ties up a slot for the plate. UltraStor is rumored to be working on an advanced connection and termination scheme that will allow four connectors (two 50s and two 68s) to coexist on the same host, with one of each type for external and the other pair for internal connections.

SCSI-2 also calls for changes in termination. SCSI-1 employed passive termination; SCSI-2 calls for active termination. In other words, SCSI-2 terminators have regulators built in to maintain the required voltage level (around 5 volts). The revision also requires better cable

construction. These two enhancements reduce problems with line noise and signal losses. When buying SCSI cables, be careful to buy high-quality shielded cables from a reliable source.

UNIVERSAL DRIVERS

But no SCSI standard eliminates a major roadblock for PC users: Neither DOS nor the PC's BIOS offers direct SCSI support. As we've noted, the resulting array of too-often incompatible SCSI drivers made installing early SCSI products a serious trial. And since DOS handles information in sectors, while SCSI moves data in blocks, there has to be software to handle the conversion. Universal drivers offer one solution that makes adopting SCSI much easier for both vendors and users.

This solution actually involves two sets of drivers, as shown in the illustration "How SCSI Works." A primary, or universal, driver lets the host adapter and the operating system communicate. You

install a second driver, or device module, for each piece of hardware on the SCSI chain; this allows the peripheral to communicate with the host adapter. Often, the universal driver is supplied by the host adapter manufacturer, along with some commonly used device drivers, such as those for popular CD-ROM drives. Third-party vendors and peripheral makers offer the rest. All of the drivers are operating-system specific: If you use more than one operating system on your machine, you'll have to get additional drivers. (But you can use a single SCSI device on multiple platforms, thanks to the fact that each SCSI device communicates with the host adapter via SCSI commands rather than via commands of a specific operating system.)

Three different camps have emerged with designs for universal drivers. The oldest solution is from Microsoft, which started by offering LADDR (Layered Device Driver Architecture) about three years ago. LADDR was designed to

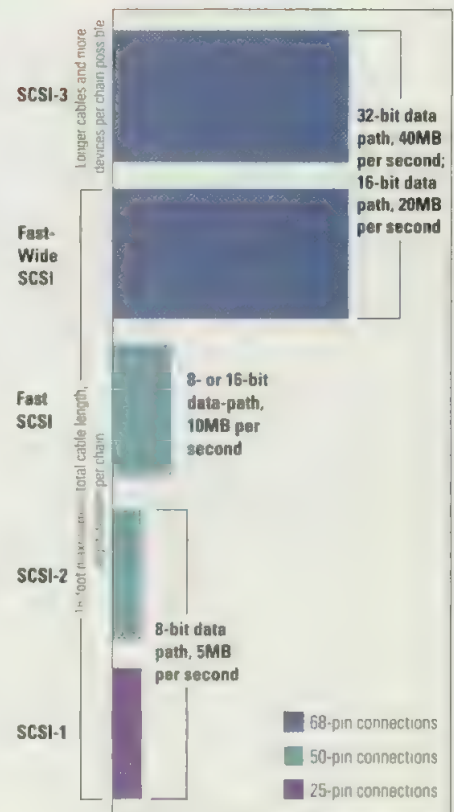
■ The Many Faces of SCSI

The SCSI standard has been through a number of reincarnations in its relatively short lifetime, and more changes are looming ahead on the horizon.

While the revisions to the standard ensure backward-compatibility, cabling schemes and transfer rates have changed a great deal (from 5MB per second under SCSI-1 to as high as 40MB per second with Fast-Wide SCSI), so has the number of commands that need to be incorporated in SCSI devices.

The SCSI-1 specification had few mandatory commands; later, a common command set was adopted as an amendment in order to make writing common drivers for SCSI applications an easier process.

SCSI-2 will add a number of additional commands that will allow easier integration of more types of devices.



make SCSI easier to use in multitasking environments. Even though it is built into OS/2 2.1, LADDR hasn't gotten wide support: Few SCSI device makers provide device module drivers for LADDR.

The Advanced SCSI Programming Interface (ASPI) appears to be the most popular universal driver approach, with a huge library of device modules available. The A in ASPI used to stand for Adaptec, the company that introduced it, but other SCSI device vendors have licensed the right to use ASPI with their products. Although DOS does not support ASPI, a base level of ASPI support is written into OS/2 2.1 and SCO ODT 2.0, and some people suspect that it is being written into Microsoft Windows NT. Operating-system support of ASPI eliminates the need for a separate ASPI universal driver, though device modules are still necessary.

According to the theory of universal drivers, swapping ASPI-based cards—loading all the devices on the new chain—should be as easy as replacing the ASPI line in the CONFIG.SYS file. And in testing, the swap required only that and a bit of musical cables. We equipped a system with an array of SCSI-2 devices—the Conner Agean Series 30540 and 560MB Micropolis Model 2105 hard disks, a \$2,195 Colorado Memory Systems 2GB PowerTape 4000 tape unit, a \$1,599 HP ScanJet IIC, a Toshiba TXM-3301-E1 CD-ROM drive (no longer in production), and a \$3,995 Panasonic LF-7010 optical drive—all running off one card simultaneously. (We tested the Panasonic and the CD-ROM drive with device module drivers from Corel Corp.'s \$99 CorelSCSI kit, the tape drive with CMS's own device module driver, and the ScanJet with a driver from Danmar Systems; we configured the two sub-1GB disks using INT 13h.) We managed this with both the Adaptec ISA-based AHA-1542C and the VL-bus based UltraStor Ultra 34F, though we did have to change the ASPI driver to the one bundled with each card (using Adaptec's ASPI driver and UltraStor's USPI driver, respectively).

Corel is the general store on the SCSI frontier and has given ASPI a real boost in the marketplace by designing ASPI device module drivers for almost every conceivable brand-name SCSI device,

■ **SCSI: Getting In Touch**

For this survey of current SCSI technology, we included products manufactured from the companies that are listed below.

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Future Domain Corp. 2801 McGaw Ave., Irvine, CA 92714; 800-879-7599, 714-253-0400; fax, 714-253-0913

Hewlett-Packard Co., Direct Marketing Organization PO Box 58059, MS 511L-SJ, Santa Clara, CA 95051; 800-722-6538, 303-350-4774; fax, 303-350-4802

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Micronics Computers Inc. 232 E. Warren, Fremont, CA 94539-7085; 510-651-2300; fax, 510-651-5666

Micropolis Corp. 21211 Nordhoff St., Chatsworth, CA 91311; 800-395-3748, 818-709-3300; fax, 818-709-3396

Panasonic Communications & Systems Co. Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000

Toshiba America Information Systems Inc., Disk Products Division 9740 Irvine Blvd., Irvine, CA 92718; 714-583-3111; fax, 714-583-3133

UltraStor Corp. 15 Hammond, #310, Irvine, CA 92718; 714-581-4100; fax, 714-581-0826

Western Digital Corp. 8105 Irvine Center Dr., Irvine, CA 92718-2937; 714-932-4900; fax, 714-932-6498

and testing them for compatibility. Its CorelSCSI software includes a wide range of DOS, Microsoft Windows, OS/2, and NetWare device drivers for CD-ROM, optical drives, jukeboxes, and other products. It will soon be expanded with the addition of scanner support. CorelSCSI provides automated installation routines that work very well for adding supported devices. In testing, for instance, the 1GB cartridge of the Panasonic drive had been formatted with 1,024 sectors per track, rather than the expected DOS 512 sectors per track. Although this method is not directly supported by Adaptec (for any of its control-

lers), when we used CorelSCSI's automatic setup routine to configure Corel's driver for this adapter, the Panasonic showed up just fine. CorelSCSI also comes with handy SCSI bus-scanning utilities that provide information about components on ASPI chains and their attributes. The package is also bundled as an extra cost option with most major host adapters.

The third universal driver solution comes from Future Domain and NCR. Designed as an alternative to provide an open interface that is not linked to Adaptec, the Common Access Method (CAM) is now an ANSI-approved protocol that

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■ SCSI: A Guide to Getting it Right

by James Karney

SCSI gives new meaning to the term *plug and play*. A single peripheral attached to a matching host adapter is usually easy to install, but when you plug several devices into a single host, things can get more complicated. The SCSI-2 draft specification, universal drivers, and easier installation routines go a long way toward making things easier. But even so, it's likely that you'll come up against at least one or two problems along the way. Here are eight tips for getting your setup to go as smoothly as possible.

1. Start simple. Start with the basics. Rather than plugging a chain of peripherals into a single SCSI card and then booting up (and confronting the confusion and possible conflicts that are likely to result), get the host adapter installed first and then install the first hard disk. You will want to continue installing devices one at a time, checking to see that they are working before moving to the next. This may seem like a bit of extra work (you will have to install and reinstall device drivers for most of the peripherals, for example), but in a complex setup, this is often a shortcut in disguise.

2. Make a list. When adding a new device, make sure that you know all of the existing SCSI identification numbers on the chain before you start installation. If you have a host adapter that reports the IDs during bootup (as the Adaptec AHA-1542C does), the task is easy; otherwise, prepare to check the jumper or switch settings on each peripheral in the chain. Or better yet, keep an up-to-date, easily accessible list of all the SCSI peripheral IDs on the chain, as well as the I/O address and BIOS (Basic Input/Output System) location of the host adapter.

Devices with low number settings have a higher priority. As a rule, you'll want to set your first hard disk at 0 and your second hard disk at 1. Host adapt-

ers are generally set at 7, and some operating systems (such as those that are Unix-based) expect to find them set there. In certain cases, some operating systems also expect other peripherals, such as CD-ROMs, to hold specific IDs; check your software and adapter manuals before installation. SCO Unix, for example, expects a CD-ROM to be located at ID 5. If you ignore such rules, the system may ignore your device.

3. Internals first. Try to install all your internal units first (starting with hard disks). But install them one at a time and *before* you start experimenting with external devices and termination. Adding an external device means you need to make a change in the devices that are terminated.

4. Observe proper termination. In a SCSI setup, each end of the SCSI chain must be terminated. If you have only internal or external devices on the bus, the host adapter and last device on the chain should be terminated. If you have external and internal devices on the chain, you will generally terminate the first and last of these devices but not the SCSI host adapter.

5. Making connections. There are a variety of SCSI cable connections: 25-pin for SCSI-1, 50-pin for SCSI-2, and 68-pin for Wide-SCSI. Look at the connectors on the items you need to attach before you buy, and be sure to obtain quality cables with good shielding. Your best bet is to buy internal and external cables as short as possible, but no shorter than one foot long (to avoid signal noise). The maximum length of cabling supported on a single bus under either SCSI or SCSI-2 is about 18 feet.

6. Check and test. Turn on any external devices *before* booting your PC; most external devices must be running to be recognized by their driver when the PC boots. If a unit (or the whole chain) fails, try the following: Check the ID numbers and cable con-

nections to make sure that peripherals requiring specific IDs are set for them and that all devices are appropriately connected. Then power-down and power-up the system, watching the messages during the initialization of the configuration files. Make sure all the drivers loaded properly.

If you can isolate an offending device, reposition it elsewhere on the chain. If that fails, change its ID number; perhaps the device is just unable to work at the ID number for which it was set. Next, try swapping cables between units and experiment with different combinations of termination, changing one element at a time. There may be a conflict, or the termination power level may not have been sufficient. In the latter case, you may have to add a terminator to the host adapter or even to another device on the chain. The rules say you should only terminate two devices, but that isn't always the case in practice. The final result should be a SCSI system that works—sometimes even if the rules say it shouldn't.

7. Managing memory. Once everything is up and running, you'll want to cut down on the amount of conventional memory all those new device drivers use. During testing, we were able to free an additional 169K of memory (from 441K to 610K) using HIMEM.SYS and EMM386.EXE with different load-high combinations. (Remember that ASPI and CAM universal drivers must be loaded before any device modules. Also remember that some ASPI and CAM drivers can be loaded high, but some can't.) Be sure to keep a clean boot disk handy when experimenting.

8. Look ahead to the outcome. If the above makes you wonder about SCSI, keep in mind its potential benefits: lots of speed and more free slots. And who knows? Maybe your installation will be as easy as plug and play. □

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6444	Ultima Home Office (internal) 289.
Sofnet	
5883	FaxWorks 2.5 (Windows & DOS) (3 1/2" only) 45.
Supra ... 5 years	
11441	SupraFaxModem V.32bis Ext. for DOS 299.
11442	SupraFaxModem V.32bis Ext. for Windows 299
Technology Concepts ... 2 years	
6315	Fax Line Manager 203 125.
TheComplete PC ... 2 years	
8593	TheComplete Communicator Gold 389.
Traveling Software	
4407	LapLink V 99.
Zoom Telephonics ... 7 years	
1494	Ext. 9600V.32 195. 3075 Internal 179.
4430	FaxModem AFX (2400 baud 96S/48R) 69.
4429	FaxModem VFX V.32bis 14,400 baud (internal) 192.
4428	FaxModem VFX V.32bis 14,400 baud (external) 215.
7921	Pocket FaxModem 87.

VIDEO & SOUND

ATI Technologies ... 5 years	
8463	VGA Wonder XL24 149. 2012 Graphics Ultra 209.
3886	Graphics Ultra + (with 2 MB) 339.
3871	Graphics Ultra Pro (with 2 MB) 519.
Boca Research ... 5 years	
10468	SVGAX3 (with Bit BCT acceleration) 149.
8380	BasicVGA 49. 8381 SuperVGA 115.
Creative Labs ... 1 year	
5770	Sound Blaster 16 229.
10906	VideoSpigot for Windows 429.

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Zoom Telephonics/Delrina Technology

4429 FaxModem VFX V.32bis Internal—Send & receive class one or two faxes at 14,400 bps. Both FaxModems provide V.42bis compression & MNP 2-5 error correction for up to 57,600 bps \$192.
4428 FaxModem VFX V.32bis External. 215.
2446 WinFax PRO 3.0—Makes it easy to send, receive & manage faxes from within Windows. Send faxes as easily as you print documents! 79.

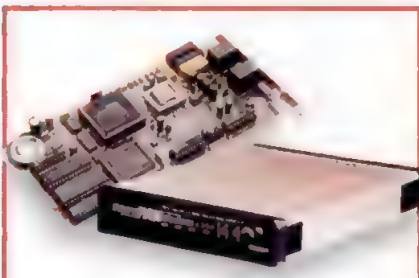
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11649 WinFax PRO & FaxModem VFX V.32bis Internal 249.
11632 WinFax PRO & FaxModem VFX V.32bis External 269.

Diamond Computer ... 5 years	
11461	SpeedStar Pro 125. 10079 Stealth 24 .. 165.
11306	Stealth Pro 1 MB 249. 11305 2 MB 339.
Hauptpage Computer ... 1 year	
10593	WinTV. Microsoft Video for Windows Bundle .. 459.
Intel ... 3 years	
11587	Smart Video Recorder 499.
KOSS Corporation ... 90 day	
11323	HD-4 speakers (with equalizer & AC Adaptor) ... 55.
MediaVision ... 1 year	
5637	ProAudio Spectrum 16 (3 yr.) 199.
11478	ProMovie Spectrum 299. 10735 CDPCXL 1099.
NEC ... 2 years	
4252	MultiSync 3FGX Monitor (14") 689.
4249	4FG Monitor (15") 799. 3151 5FG (17") 1449.
Video Seven ... 7 years	
7362	WIN.VGA 1 MB 129. 9261 WIN.PRO 1 MB 179.

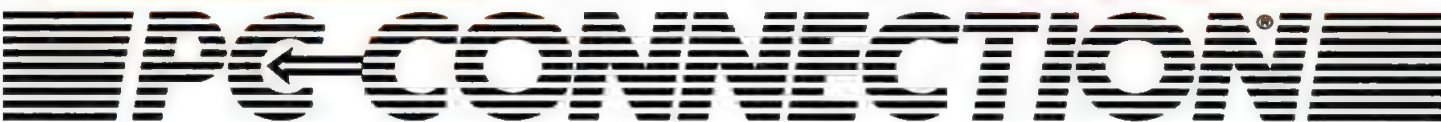
INPUT/OUTPUT

Caere ... 1 year	
8158	Typist Plus Graphics 299.
Canon ... 1 year	
We are an authorized Canon Service Center.	
7809	BJ-200 BubbleJet Printer 355.
9037	BJ-300 469. 9038 BJ-330 529.
CoStar ... 1 year	
10300	Address Express 689.
Epson ... 2 years	
11495	Stylus 800 (1 year warranty) 379.
5555	AP-3250 (80 col., 200 cps, 24 pin) 199.

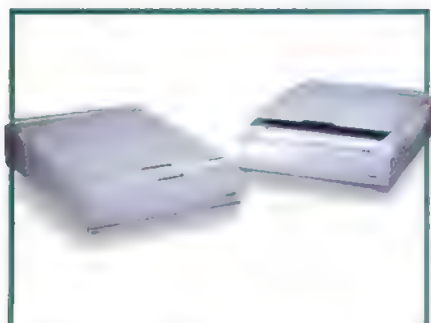


Supra ... 5 years

SupraFaxModem V.32bis—Features 14,400 bps fax and data. Comes with choice of DOS or Windows software. External includes cable. DOS: 11440 Int \$219. 11441 Ext. \$299. Windows: 11443 Int 219. 11442 Ext 299.



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Microtek ... 1 year

5187 *ScanMaker II*—The ScanMaker II and the superfast ScanMaker IIx offer affordable ways to capture 24-bit color or 8-bit gray-scale images at up to 1200 dpi. **\$879.**
5175 *ScanMaker IIx with PhotoStyler*. **1099.**

2358	LQ-570 (80 col., 252 cps)	249.
10784	Action Laser 1500 (1 MB)	889.
10752	ES800C Color Scanner (requires interface kit)	895.
Hewlett-Packard ... 1 year		
7621	DeskJet Portable	439.
6442	LaserJet 4 (with toner)	1499.
Kensington Microware ... 1 year		
7899	Expert Mouse serial... 89. 7900 bus	115.
Key Tronic ... 3 years		
4518	101 Plus Keyboard	99.
4387	Trak 101 Keyboard (with trackball)	165.
Logitech ... limited lifetime		
3996	Trackman2 (combo)... 79. 2343 Portable	99.
3295	Mouseman (combo)... 69. 9766 (cordless)	89.
Microsoft ... lifetime		
7597	Microsoft Mouse (bus or serial)	85.
1896	Ballpoint Mouse (serial only)	119.
2898	Mouse with Windows 3.0 (bus or serial)	149.
MicroSpeed ... 1 year		
6007	PC-TRAC Trackball serial	75.
Microtek ... 1 year		
5187	ScanMaker II 879. 5175 ScanMaker IIx	1099.
Mouse Systems ... lifetime		
7878	PC Mouse III (serial)... 69. 5427 NewMouse	62.
Mustek ... 1 year		
8452	Gray Artist for Windows (256 GS hand scanner)	165.
Okidata ... 1 year		
5093	OL400 Laser Printer	649.
9590	OL810 Laser Printer	1089.
Pacific Data ... lifetime/60 day MBG		
5729	ProTracer (personal CAD printer) (1 yr.)	1099.

ACCESSORIES

American Power ... 2 years			
7108	Smart UPS 400....	339.	7105 Smart 600 439.
3819	Back-UPS 250.....	115.	3858 Back 400..... 179.
7107	Back-UPS 450.....	215.	3823 Back 600..... 295.



Prometheus ... 5 years

6444 *Ultima Home Office*—Internal, integrated communications system. 14,400 modem, send/receive fax and digital voice messaging, featuring MaxFax voice/fax software... **\$289.**
7776 *Home Office Modem (internal)*. **179.**

Curtis ... lifetime		
7358	Command Center SPF-4.....	\$79.
Cyrix Corporation ... 5 years		
9875	FastMath 83D87-25 or 9876 83D87-33.....	ea. 89.
Intel ... 3 years		
4750	80387SX..... 79. 5409 80387DX	85.
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9537	CPU Cooler (for 386/33 up to 486).....	29.
3203	Turbo Cool 200 149. 7915 Turbo Cool 300 159.	159.
Targus ... lifetime		
1305	Universal Notebook Computer Case.....	69.
11207	Leather Notebook Computer Case	89.
Tripp Lite ... 2 years		
8190	Isobar 4-6 (4 outlets, Gold Seal Warranty).....	49.
8200	Isobar 6-6 (6 outlets, Gold Seal Warranty).....	59.
9312	BC500 Power Backup	219.

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Colorado Memory Systems ... 1 year		
4354	Jumbo 250 Tape Backup	215.
1073	Trakker 250 Tape Backup (parallel)	429.
Conner Peripherals ... 1 year		
2339	CP30104H 120 MB IDE HD (19 ms)	269.
1337	CP30204 210 MB IDE HD (16 ms)	349.



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6499	Transportable 90 PRO	659.
10452	Transportable MultiDisk 150	849.
6344	PC Powered 90 PRO (includes PC28, cartridge & Central Point Software).....	599.
10537	PC Powered 150	799.
10457	Dual MultiDisk 150	1899.
2530	90 MB Cartridge..... 149. 2467 Tripak	439.
8480	Tape250 Insider Tape Backup	199.
8481	Tape250 Inside Half-Height Tape Backup	209.
10702	Tape250 Parallel Port Tape Backup	429.
8482	Tape250 PC Powered Tape Backup	319.
NEC ... 2 years		
6582	CDR74-1 Portable CD-ROM Drive	629.
6581	CDR84 Internal CD-ROM (reqs. interface)	589.
Quantum ... 2 years		
8287	Plus Hardcard II XL 105 MB (9 ms)	279.
4735	Hardcard EZ 127 MB IDE (17 ms)	329.
4714	Hardcard EZ 240 MB IDE (16 ms)	549.
TEAC ... 1 year		
6951	1.2 MB Drive for AT	59.
4670	1.44 MB Drive (3 1/2")	55.
4326	1.44 MB Drive (3 1/2", with Bastech)	75.
4414	3 1/2"/5 1/4" Dual Floppy Drive	145.

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1411	1 MB x 9 SIMMs (70 nanosecond)	call
2497	4 MB x 9 SIMMs (80 nanosecond)	call
5746	1 MB Chips (80 nanosecond, set of 9)	call
Boca Research ... 5 years		
7150	BOCARAM/AT PLUS (2 MB)	169.
7139	(4 MB)..... 239.	7138 (8 MB)..... 449.
6998	I/O Board for AT.. 49.	6999 for PS/2..... 89.



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Intel ... 3 years

11587 *Smart Video Recorder*—Power and performance! Fifteen times faster for one-step capture and compression of 1.4 screen video onto one-fifth the hard disk space. **\$499.**

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1086	Matched Memory Classic Memory Board OK	95.
8479	Above Board ISA OK	179.
	Pacific Data ... lifetime/60 day MBG	
	Memory upgrade for LJ IIP, III, IID, IIP:	
7055	2 MB.....	119. 7759 4 MB.....
7959	4 MB Upgrade for LaserJet 4	165.

DISKS/MEDIA

Fuji ... lifetime				
2214	3 1/2" DS Disks (10).....	9.	2242 (50).....	32.
7379	3 1/2" HD Disks (11).....	13.	2241 (50).....	59.
4863	3 1/2" HD Disks (20) with storage case			25.
Sony ... lifetime				
3292	5 1/4" HD Disks (10).....			11.
3297	3 1/2" DS Disks (10).....	9.	6148 (30).....	25.
3298	3 1/2" HD Disks (10).....	14.	6375 (30).....	39.
8185	QD2040.....	14.	1895 QD2120.....	19.
3M ... lifetime				
1581	DC2120.....	22.	11013 (3 pack).....	60.
Tohiba ... lifetime				
4858	3 1/2" 2.88 MB ED Disks (5).....	17.	9755 (10).....	29.

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240 MB Hard Drive, PFS: WindowWorks, MS-DOS 5.0
and Windows 3.1, 5 1/4" Drive, Modem (2400 data,
9600/4800 S/R fax), Prodigy**\$1759**

9553 LTE Lite 3/25c Color Model 120/w
25-MHz 386SL, 4 MB expandable to
20 MB, 120 MB Hard Drive MS-DOS 5.0
and Windows 3.1**\$3499**

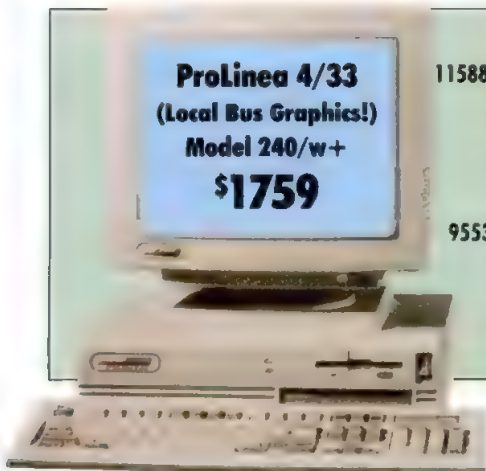
11646 DESKPRO 4/66M Model 510/w
66-MHz 486DX2, 8 MB expandable to 32 MB,
QVision 1024 Graphics, 510 MB Hard Drive,
MS-DOS 5.0 and Windows 3.1**\$3649**

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allows several host adapters to be controlled from a single driver. OS/2 2.1 and Unix SCO ODT 2.0 currently offer virtual device driver support for CAM within the operating system.

Today the real-world differences between using CAM and using ASPI are minimal. The main handicap of CAM is that ASPI was here first, and there is little momentum to replace it with CAM. In fact, Future Domain and NCR remain the only major players to support CAM.

The latest salvo in the CAM-ASPI feud is collaboration. Future Domain is not giving up on CAM, but it plans to provide the CAM-to-ASPI converter (in beta when we saw it) free as part of its PowerSCSI! package. That approach allows use of ASPI device drivers in a CAM environment, so that CAM-based cards will be able to support both CAM and ASPI modules in the same system. In testing, we replaced a VL-Bus BusLogic BT-445S (\$499) VL-bus host adapter (which uses ASPI-based drivers) with a Future Domain TMC-1680 CAM-based controller. With a beta copy of PowerSCSI! loaded, we were able to coax the Future Domain TMC-1680 controller to drive the Panasonic drive, the Toshiba CD-ROM drive, and the HP scanner using CorelSCSI and other ASPI device modules...all without fuss. (PowerSCSI! should be shipping for free with Future Domain products when you read this.)

EASIER INSTALLATION

SCSI is beginning to see dramatic changes in the way the host adapter is integrated with the PC operating system and the way the devices are installed. For example, for some host adapter cards there are all but automatic installations.

Not all adapters are created equal, however. Take, for instance, the ASPI-based Adaptec AHA-1542C and the ASPI-based UltraStor Ultra 34F VL-Bus adapter. The Adaptec AHA-1542C has one of the best firmware setups going; there are no jumpers and only one bank of DIP switches to control its SCSI ID and memory address. Holding the Ctrl-

A combination during boot-up accesses the adapter's firmware with easy-to-use menus for setting up the card, termination, advanced support options, and hard disk formatting. The Fast SCSI UltraStor Ultra 34F, on the other hand, still has jumpers and switches to set. In testing, we had to fiddle a bit with resetting jumpers to get the memory addresses right.

In its most advanced form, an automated installation routine for ASPI or CAM features a setup program that scans the SCSI bus, identifies all supported

adapter and CD-ROM ID numbers matched those called for in the operating system manual, then booted from a floppy disk and confirmed our options. Once that was completed, everything else was automatic. We did not have Unix setup files for the scanner and Panasonic drive, but leaving them attached (and not functional) posed no problems.

BEYOND DOS

SCSI's appeal extends to multitasking operating systems with features such as command-tag queuing. Instead of sending a single command and waiting for a reply, the host can send several commands and rearrange processing for maximum efficiency. SCSI-2 improves on the SCSI-1 spec by providing a clear methodology for this feature, allowing for up to 255 tasks to be handled by a single host adapter at one time. Most host adapters offer their own bus-mastering within the SCSI

bus (even on ISA systems) and the latest ones support multitasking—their coprocessors can handle several requests from different devices on the bus at the same time. Some host adapters can also reshuffle the queue order, giving priority to certain commands. Devices use the bus only when they are moving data or commands, unhooking to process data, and can access memory without using the PC's standard DMA channels. A hard disk could be backed up to a tape drive while the system accesses another peripheral.

While DOS may not be able to use this multitasking power, these features can be a real advantage in environments such as Windows NT, OS/2, Unix, or on networks. Of course, these features have benefits only when you have more than one item attached to an adapter.

HERE AND GETTING BETTER

As you can see, vendors have not waited for SCSI-2 to be signed before adopting it. Almost every device we used for testing was compatible with the draft of SCSI-2. As demonstrated by the scarcity of compatibility problems during our testing, you can generally feel safe that a product compatible with the SCSI-2

SCSI is beginning to see dramatic changes in the way the host adapter is integrated with the PC operating system and the way the devices are installed.

hardware on the chain, and loads drivers for DOS and Windows' 386 Enhanced Mode and updates configuration files.

The Adaptec AHA-1542C is bundled with Adaptec EZ-SCSI software, based on ASPI and able to work only with Adaptec controllers. Adaptec EZ-SCSI almost totally automates most SCSI installations. It identifies all the Adaptec host adapters and their attached peripherals, then it loads the appropriate drivers for supported products. Similarly, the beta copy of PowerSCSI! we saw automatically searches for Future Domain adapters and their attached peripherals (whether they are ASPI or CAM), as well as identifies INT 13 devices, and then offers to load appropriate drivers.

Installing SCSI devices on a PC running Unix, such as SCO ODT or Solaris, is even easier, since Unix offers direct support for SCSI. If you are using a recognized host adapter and devices, you won't need special drivers. If not, many vendors provide special setup files that add support right into the operating system. In testing with SCO ODT loaded onto the second partition of the Micropolis 560MB disk, we found the basic installation fairly easy: We just made sure the

HARDWARE
SCSI Technology

draft will be compatible with the final, official SCSI-2 specification.

The standard writers and developers aren't wasting any time in finding ways to make SCSI better. The *SCSI-3* spec is already in the works, although it won't be a reality for at least another year. Unlike SCSI-2, it does not directly set forth new performance protocols, but rather refines how SCSI works. In addition to formally including the new 68-pin Wide SCSI P connector, for instance, it may also specify the use of fiber-optic cables. Other possible modifications include longer cable lengths, bus fairness (a scheme to move the most packets across the bus in the shortest amount of time, regardless of what might be directly in the queue), and support for more than eight devices per chain (possibly through a scheme that will make daisy-chaining host adapters easier than is currently possible, or by increasing the number of available SCSI IDs you can run off a single host adapter).

Another area that is gaining interest is *Serial SCSI*, a scheme that uses just six pins. Merely mentioned in the SCSI-2 draft specification, Serial SCSI should be expanded in SCSI-3. With very fast transfer rates (even beyond Wide SCSI, though no exact specification yet exists) and small connectors, Serial SCSI has the potential to replace the existing 50-pin and 68-pin connectors. While Serial SCSI may not make the older host adapters and cables obsolete overnight, it does make cabling possibilities even more of a puzzle. Serial SCSI offers the possibility of longer cable length, less electromagnetic interference, and easier connections on laptops, notebooks, and docking stations. Expect almost pain-free installations with auto ID setup and termination schemes.

Several system makers already ship products (mostly servers) with on-board SCSI, including Compaq's ProSignia line, Zeos' 486DX2-66, and Zenith Data Systems' Z-Station line. Now Adaptec and other vendors are working on single chip SCSI RISC processors for motherboards and host adapters. A RISC implementation of SCSI could offer faster command processing and intelligent caching. Some of these products will center on the VL-Local bus, but some vendors have hinted

they plan to wait for the new Intel PCI local bus. AMD and Phoenix recently announced the availability of a system BIOS for the PC that supports the NCR 53C810 PCI/SCSI RISC controller chip, now available, that implements a complete SCSI-2 host adapter while taking up less than 2 inches on the motherboard and connecting directly to the PCI bus.

Today, innovative products like

Adaptec EZ-SCSI, PowerSCSI! with its CAM-to-ASPI converter, and the new Adaptec AHA-1542C firmware are making SCSI almost painless. With transfer rates far above any competing technology, gigantic drive capacities, and the benefit of leaving expansion slots free, SCSI is the logical interface for power users, multimedia applications, and network servers. □

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With price, functionality, and performance still separating the dozens of available V.32bis high-speed modems, finding the one that's right for you demands careful comparison.



Remember when any number of books and magazine articles about modems would reliably misinform you that modems operating on standard phone lines could go no faster than 1,200 bits per second (bps)?

Well, you've known for a long time that that's not true. But are you ready for 14,400 bps? Ready or not, 14,400 bps is here.

Not that long ago, modems were on the verge of becoming purely generic hardware, with relatively few differences—and even fewer perceived differences—among them. The de facto business standards were 2,400-bps speed and the Hayes Smartmodem

2400 command set. These two standards had prevailed for so long (starting in about 1984) that feature sets for most modems were much the same.

Today, modems are changing too rapidly for any new combination of features to have established itself as a mainstream standard. Instead, steadily falling prices have ensured that each new advance in capabilities—faster speed, error control, data compression, and fax support, for example—has ratcheted up the minimums for what the new business standard will eventually become.

The current candidate for the business standard, as demonstrated by the modems we looked at for this overview, is 14,400-bps speed, using V.32bis

by M. David Stone

modulation protocol along with V.42bis data compression and V.42 error control. The last time we looked at V.32bis modems, only 10 external models were available. The number has grown to 62 at this writing. And about four-fifths of those are already raising the minimums again by adding Group 3 fax support.

Most important for the candidacy of V.32bis modems as the standard is that the modems as a group are more reliable than they were a year ago: They are much more likely to connect at 14,400 bps over less-than-ideal phone lines.

The price difference between V.32 and V.32bis modems from the same manufacturers is typically about \$100. And prices for V.32bis modems start at \$249, although for the modems reviewed here, list prices range up to \$1,199 (for NEC America's NEC N9635E Plus). Of the 62 modems reviewed here, 18 have a list price of under \$400, and 9 are under \$300.

In our last look at modems, we pointed out that you couldn't count on a 14,400-bps connection unless you had consistently high-quality phone lines and could be sure you would have the same brand of modem on both sides of the link. But with the current batch, at least some can handle any reasonable line conditions. And with most modems, interoperability is no longer the problem it was.

Whatever the overall improvements in the breed, however, quality still varies among the dozens of modems available. To begin with, you'll find significant performance differences. Scores on ZD Labs' unidirectional Protocol Throughput test, for example, ranged from a low of 2,079 characters per second (cps) for

Megahertz Corp.'s 14400 Data/FAX Modem to a high of 5,957 cps for the AT&T Comsphere 3830.

Complicating the choice further is the absence of any one modem that is best for all purposes. If you're interested strictly in data communications, the AT&T Comsphere 3820 SD and 3830 are the best available. The two modems offer the highest one-way throughput scores in the batch, and none of their performance scores are far from first place. But neither

offers fax, for example, and others outperform them slightly at specific tasks.

So even if you're concerned only about performance, picking the best modem is not a straightforward procedure. And of course, performance isn't the only factor you should be concerned with. Features matter too—starting with the underlying communications capabilities, such as the protocols supported.

Eight sets of key factors should determine your buying choice: the modem's

HIGHLIGHTS

V.32bis Modems

WE COVER 62 V.32bis modems. They all run at 14,400 bps and offer V.42 error control, V.42bis data compression, and compatibility with most previous mainstream standards. A few also offer less common protocols; 50 offer Group 3 fax compatibility.

RELIABILITY AND PERFORMANCE

differentiate these modems. Compared with the modems we tested last year, they are more likely to connect at 14,400 bps over real phone lines and are much more likely to connect with modems from other manufacturers. Significant performance differences do exist among the modems we cover, however. Some had problems on our tests, even on a best-case line. And on one test, the best-performing modem—the AT&T Comsphere 3830—was 2.9 times faster than the slowest performer.

NO ONE MODEM performs best at all tasks. Some do well moving uncompressed data in one direction only, as with an on-line database system. Others shine at moving already compressed files, such as zipped BBS files. Still others stand out at two-way communications, as with a remote-control program or a LAN-to-LAN bridge. And some scored better than others on interoperability with modems from other manufacturers.

STATUS INFORMATION varies greatly among modems. The combination of

error control, data compression, different modes for each protocol, and the wide range of possible speeds yields a lot of important information about a connection. Some modems ignore the need for this information. But the modems that provide critical feedback will help troubleshoot problems and save you money by letting you hang up when you don't get the level of connection you expect. Modems that offer the information as text on an LCD are preferable to the devices that use status lights, because the information is quite a bit easier to read on an LCD. Some modems offer both. In addition, two modems display LED icons.

SPEND THE \$50, buy fax. Modems with Group 3 fax capabilities cost only about \$50 more than those without the capabilities, making fax well worth acquiring, even if you use it only occasionally.

SOFTWARE COMPATIBILITY may be crucial. If you have custom scripts or use a specific on-line front-end, you'll want a modem with the greatest chance of working with most software programs. Look for a modem that is very similar to a specific Hayes model, since most communications programs support Hayes modems. Note that the phrase "Hayes-compatible" is nearly meaningless, since Hayes itself offers several significantly different command sets for its modems.

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EDITORS' CHOICE

performance; the set of protocols it supports for modulation, error control, and data compression; its support, if any, for faxing, along with its fax performance and command set; its compatibility with software, as determined in large part by its command set; the status information it provides to help you both judge the quality of a connection and troubleshoot problems; some lesser issues such as the size and shape of the case, the quality of the documentation, and bundled extras such as software; the technical support offered by the company; and the terms of the warranty. Before looking at these issues, however, it's important to understand some details about the modulation, error-control, and data-compression protocols that form the foundation for modem communications.

RIISING STANDARDS

The recent pattern of raising the ante on features every few months started in late 1990, with the introduction of relatively inexpensive (under \$1,000) modems that used the 9,600-bps V.32 modulation protocol. Because 9,600 bps pretty much requires error control for reliable communications on standard phone lines, these modems also included error-control protocols, which let modems detect errors in received data and ask for a retransmission. In effect, higher-speed modems converted error control from a luxury option to a basic feature.

Some of the early V.32 modems used MNP 4, which had been developed by modem manufacturer Microcom Systems and which was then the most widespread standard for error control. V.42 quickly replaced MNP 4 as the error-control standard of choice, however. V.42 is an official CCITT (International Telegraph and Telephone Consultative Committee) recommendation and includes MNP 4 as a fallback mode.

Close on the heels of error control came data compression, which lets modems use a kind of shorthand for patterns that repeat often in any given file (such as the word *the* in a text file). As with error control, data compression had been available for years as a luxury option. But because data-compression schemes are designed to work over error-controlled

dem on the market. In our March 17, 1992 issue, we gave an Editors' Choice to an earlier Comsphere modem, the 3810, and we are not surprised to see AT&T's unit once again at the top of our test charts. Its numerous indicators and rock-solid connections are most impressive. AT&T also has a deservedly excellent reputation for quality assurance and industry-leading technology. The \$795 AT&T Comsphere 3830 is a pleasure to use.

The Comsphere 3830 does not offer fax capabilities, however. For users who want fax in the box, we recommend the \$989 ZyXEL U-1496plus. The ZyXEL was also the only tested modem to offer (proprietary) 16,800-bps and 19,200-bps modulation methods. Its feature set is impressive, with everything from an LCD to support for caller ID. It's slightly slower than its sibling, the U-1496E, but its performance is still acceptable.

The AT&T and ZyXEL modems

links, and because most modems didn't offer error control, most modems didn't offer data compression, either. When error control became a standard feature for V.32 modems, data compression became a natural follow-up.

Not surprisingly, as prices dropped, more and more V.32 modems offered data compression as well. When inexpensive V.32 modems were first introduced, the only widespread data-compression protocol available was Microcom's MNP 5. Within a year, however, V.42bis—another CCITT recommendation—replaced MNP 5 as the data-compression

are both impressive but somewhat expensive. For the cost-conscious buyer, we recommend Boca Research's \$495 14.4Kbps External Boca Modem, with 14,400-bps capabilities for both data and fax transmission as well as excellent speed and interoperability.

And for the road warrior, we award an Editors' Choice to the \$499 Practical Peripherals PM14400FX PKT. Travelers will appreciate its clever design (if you're willing to run the modem on AC, you can leave the battery pack at home), its use of AA (rather than 9-volt) batteries, and its decent complement of indicator lights.

Two modems merit Honorable Mention. The Motorola 3260 is a bit pricey, but its interoperability is wonderful and the modem is available with the Codex FAST 24Kbps scheme. And UDS Motorola's Fast-Talk 32bx could improve its interoperability but was otherwise an excellent performer.

protocol of choice. Today, it would be difficult to find a V.42 modem that didn't include V.42bis.

Other recent additions to the mainstream business modem include fax capability—starting with send fax, and now including send and receive features—and, of course, the move to 14,400 bps with V.32bis. On the horizon (probably available by the time this is published) are modems with voice-mail capabilities and the ability to discern distinct rings for different phone numbers on the same line (a feature offered by some telephone companies).

Another enhancement, the V.fast protocol, is currently slated for mid-1994. If all goes as planned, V.fast will provide 24,000-bps transmission over standard phone lines and will be the last modem protocol before the current phone network is replaced by a fully digital ISDN (Integrated Service Digital Network).

These developments have not only made the new business standard for modems an elusive goal, they have led to far greater differences among modems than you might expect from past experience. The differences show up in both performance and features, and are so obvious that even the most casual user can't miss them.

THE MORE THINGS CHANGE...

In truth, the differences among modems are all but inevitable. The move to error control and data compression, for example, requires a new set of commands. And given the lack of any single, unarguable standard, different manufacturers have gone with different commands. Some use the Microcom commands originally developed for Microcom's MNP modems in 1982, some use the Hayes commands originally developed for the Hayes V-Series modems in 1987, and some have created their own set of commands.

The combination of error control, data compression, and a larger range of possible speeds creates the need for more information about the status of a connection. But manufacturers have come up with almost as many approaches to the additional information as there are modems. As we'll discuss later, the solutions range from elegant to less than satisfactory to absent altogether.

As with most hardware, performance for modems is a more critical issue than features. Modems have always varied in performance, particularly in their abilities to connect reliably and transfer data over impaired phone lines. But as with almost any technology, as the field matures, even lesser representatives of the breed tend to have fewer problems.

The technology for 2,400 bps or less has long been mature enough to require a rigorous series of tests to uncover any noticeable difference between the best and worst modem. The technology for

14,400 bps is nowhere near that mature.

In our tests on a Public Switched Telephone Network simulator, with controlled line conditions, the modems fell into four broad categories. Some worked on every tested line condition without problems, some worked on every tested line condition but had trouble transferring the entire suite of files, some had

V.32bis technology is maturing rapidly. Many of the modems included here have even improved over the course of our testing.

trouble on anything but a best-case line, and some had trouble even on a best-case line.

In practice on real phone lines, the difference between a modem that works under every reasonable line condition and one that does not can be obvious. To prove the point, we ran informal real-world tests on three different modems. Only one of the three modems we selected proved able to work under every tested line condition.

Any modem will occasionally fail to connect. But two of the modems in our informal testing failed far more frequently than the third. More important, when line conditions were consistently marginal for whatever reason—on a rainy day, for example, when phone lines may have been soaked—the two less capable modems failed repeatedly, while the more robust modem still worked reliably.

The good news is that V.32bis technology is rapidly maturing. In fact, many of the modems included here have improved even over the course of our tests, with manufacturers acknowledging problems we found and then solving them in time for retesting. In all such cases, we report the results for the improved ver-

sion of the modem, because that's the version the company is now shipping.

Generally, we've seen over the last several months that modem companies have been solving problems on an ad hoc basis as they come across them. It's worth pointing out that most such problems show up under oddball conditions, none of which you'll run into very often. But as each additional problem is discovered and solved, odds of running into any problems fall.

ZyXEL modems offer a good example. ZyXEL has been improving its modems incrementally by updating ROMs. And the effort shows. The ZyXEL modems have passed through ZD Labs three times in the last several months, improving each time. They are now among the best performers in the batch.

REVIEW CRITERIA

For our roundup, a modem had to offer V.32bis modulation at 14,400 bps with V.42bis data compression. It also needed to be shipping as of January 8, 1993. In addition, we limited the field to external modems that could connect to a standard PC or AT serial port. Missing from this overview are internal modems for desktop and portable computers, including PCMCIA modems.

We focused on external modems because, unlike internal modems, they provide lights and other indicators that offer valuable information about the modem connection. They also will work with any computer that comes equipped with an appropriate serial port.

Aside from their lack of status information, internal modems typically are, of necessity, limited to specific buses or, in the case of portable computers, limited to one or a few computer models. PCMCIA modems present special problems. We have yet to find an appropriate socket adapter that will let us connect a PCMCIA modem to the 80486-based desktop machines we use for our test-bed.

Three companies offer or have offered external V.32-bis modems that are not fully cov-

FEATURES PLUS

Learn more about emerging modem technology from June 21-25 in ZiffNet's Executives On-line forum, hosted by M. David Stone and guests from many modem manufacturers. Type GO ZNT-EXEC at any CompuServe prompt.

■ Crunching The Numbers

How much data can a single modem test generate? A lot. In testing with various files, for example, we created 30 throughput scores per modem. In fact, most published modem tests leave you with a morass of numbers to sort through.

There has to be a better way, we thought. So we developed the Protocol Ratio, an effective summary of each modem's performance over a range of data files.

Like any summary, the Protocol Ratio gives a very broad perspective. It cannot account for the nuances of a particular environment. For that, you'll want to consult each modem's individual performance scores. But for an overall sense of modem capability, the Protocol Ratio is the best single index that has been created to date.

Calculating the Protocol Ratio requires a series of steps for each modem. First, we run the 30 versions of our Protocol Throughput test three times each. Next we calculate the geometric mean of the trials for each test configuration, producing 30 Protocol Throughput scores; five of these represent unidirectional data transfer, and 25 are bidirectional. To simplify the data, we calculate a geometric mean of each group of bidirectional scores. Our preliminary result, then, consists of five bidirectional and five unidirectional scores.

To summarize each modem's performance when passing compressed and uncompressed files, we want to express the *actual throughput scores* as a fraction of the theoretical limit, or *reference throughput*—the best possible throughput the perfect modem would achieve for each file.

We calculate this reference throughput using the *reference data rate* of a V.42 connection without compression. This rate is about 1,728 characters per second (cps) for a 14,400-bps modem (the exact number depends on the data packet size, frame-forward strategy, and other design variables in the modem). We multiply this figure by the *optimal compression ratio* (a set value). If the result is higher than one-tenth of the modem's maximum DTE (data-terminal equipment) rate, we use the DTE-based throughput rate instead. In the adjoining table, we summarize the results for each type of modem (in terms of maximum serial-port speed).

For a given modem, we divide each of our ten preliminary scores by the appropriate reference throughput, yielding five unidirectional and five bidirectional ratios. Since most applications are unidirectional, we weight the unidirectional ratios heavily in computing a geometric mean. This is the modem's overall Protocol Ratio, as shown in the test charts.



ered here: Dallas Fax, Logicode Technology, and PerfectData Corp. Both Dallas Fax and Logicode sent modems for this review, but both products were subsequently dropped from the testing: Dallas Fax's modem because the company is no longer in business, and Logicode's because the company planned to discontinue its line of V.32bis modems. Because Dallas Fax modems may still be available, we report the results here for reference only. We do not report the Logicode modem results, except to note that the device failed the Protocol Throughput and Data Pump tests.

PerfectData asked to withdraw its modem from the overview because of the product's Data Pump test results. Our policy, however, is to review all products submitted for testing unless they have been withdrawn from the market. Unfortunately, PerfectData declined to confirm the information in our Summary of Features. As a result, we report the only the test results of the PerfectData modem. None of the modems from these three manufacturers are included in any other statistics cited in this article.

The 62 modems that met our criteria comprise 50 desktop modems and 12 portables. We ran each through a suite of performance and software compatibility tests. The performance tests follow the new Telecommunications Industry Association TIA PN2826 Modem Performance Measurement Methods test methodology. To the best of our knowledge, these are the first publicly available results based on the new testing recommendation. (For a description of our testing, see the sidebar that accompanies the test results.)

We also evaluated each product for modulation schemes, error-control and data-compression features, physical characteristics, status indicators, manual controls, command sets, support, documentation, and software and hardware extras bundled in the package. For modems that include fax support, we ran fax performance and fax quality tests as well.

You won't find individual reviews anywhere in this article. We detail the features for each modem in the Summary of Features table and chart the performance test results. We discuss below the various characteristics you may want to

Ideal Modem Performance by DTE Speed

Maximum DTE speed	File 1	File 2	File 3	File 4	File 5
115,200 bps	13,690	4,345	2,664	1,725	7,695
57,600 bps	5,760	4,345	2,664	1,725	5,760
38,400 bps	3,840	3,840	2,664	1,725	3,840

How We Tested

No modem is perfect at faxing and sending data. The AT&T Comsphere series is tops in data throughput, while modems from American Data Technology, Intel, Multi-Tech, and Practical Peripherals had the best fax showings.

To test every aspect of these modems, we ran each product through two data throughput tests, a data pump test, two fax tests, and an interoperability test. All except the interoperability test are represented in the charts that follow. The interoperability test examines how each modem functions with three commonly used modems; we report the results in the sidebar "Pursuing the Holy Grail: Modem Interoperability."

We based the two data throughput tests—one that evaluates a modem's compression engine and one that tests the data pump—on a methodology developed by the Telecommunications Industry Association (TIA). We ran these throughput tests under four line conditions, passing five different files through each type.

Two TIA documents describe the data throughput tests. *TIA Telecommunications Systems Bulletin 37 (TSB-37)* describes the line conditions; the throughput test is in the working documents of a TIA subcommittee (*TR-30.3*). *TSB-37* describes the correct order for inserting transmission problems, or impairments, into the circuits for testing. *TSB-37* provides ten sets of impairments; each set is known as an Impairment Combination (or IC) and is identified by a number from 7 through 16. (Numbers 1 through 6 refer to an old, 2,400-bps modem-testing standard.)

We used four combinations of these sets: IC9 (a satellite-based connection, with a 350-millisecond transit delay), IC10 (a very poor, land-based, coast-to-coast connection), IC14 (a 400-mile, long-distance connection with a 6-mile link between the modem and the central office), and IC16 (an acceptable, 400-mile long-distance connection). We passed five standard test files three

times each over these line conditions.

Each file is 32K long and is identified by a number from 1 to 5. The testing software sends as many repetitions of a single file as necessary to transmit 1 million bits through V.42 error control.

File 1 is an ASCII file that is similar to the output stream of a plotter; it has a reference compression factor of 7.922 to 1. File 2 is a part of a larger Word-Perfect file and has a reference compression factor of 2.514 to 1. File 3, a combination of bitmapped images, font changes, and text, is part of a desktop publishing file. It has a reference compression factor of 1.542 to 1. File 4 consists of random bits, intended to represent a zipped or other precompressed file; it has a reference compression factor of 0.998 to 1. File 5 is the file the CCITT used when developing the V.42bis standard; its reference compression ratio is 4.453 to 1.

After running each test three times, we calculated a geometric mean of the successful results only. (The geometric mean reduces the impact that any individual data point will have on the results.) If the modem could not transfer any data at all, we report its score as "N/A" (not applicable).

ZD Labs' unique, automated software ran the data tests. The software, designed by Satchell Evaluations (a modem consulting firm), ran on a 486/33 Northgate SlimLine SP 433 with the Hayes ESP Communications Accelerator for Windows, a board with two serial ports. The board was equipped with a pair of NS16550AFN FIFO UART chips. A PSTN (Public Switch Telephone Network) transmission simulator, from Processing Telecom Technologies (PTT), provided the four simulated telephone connections. Each simulator consisted of a PTT 5102 Tele-

phone Network Simulator, a pair of PTT 5151 Advanced Impairments Simulators, and a PTT 5200 ISDN/DDS Cable Simulator with two local-loop modules installed. We used a Hewlett-Packard 4947A Transmission Impairment Measuring Set to monitor the quality of the connection simulators each time the equipment was set up.

The **Protocol Throughput** test measures the effectiveness of the modem's V.42bis compression and V.42 error control. This test uses IC16 to minimize the effect of bit errors on throughput. We test with pairs of identical modems and measure the throughput during unidirectional and bidirectional transmissions. For bidirectional testing—one file transmitted in each direction—we use all 25 possible combinations of the five test files (files 1 and 1, 1 and 2, 2 and 1, and so on). For each modem, we compute a geometric mean of the 5 unidirectional scores and a geometric mean of the 25 bidirectional scores. The 30 scores are also synthesized into a separate value, the **Protocol Ratio** (see the sidebar "Crunching the Numbers" for more information).

The **Data Pump** test evaluates how well the data pump deals with defects in the transmission circuit. We send File 4 in unidirectional and bidirectional transfers over three different line impairments:

IC9, IC10, and IC16. Because satellite connections are rare on public networks, we do not include failed satellite connections (IC9) in the final results. We then synthesize the six numbers into the **Data Pump Ratio** (a measure of actual performance expressed as a fraction of the theoretical limit).

FACSIMILE TESTING

To determine which of these data modems offers the best fax performance option, we send a text file (the **Text File** test) and a graphics file (the **Graphics File** test) under WinFax Pro 3.0. We report the total connection time for each.

We perform all of our fax testing on the PSTN Transmission Simulator using *TSB-37* Impairment Combination (IC) #14. We use both the PSTN transmission simulator and a Consultronics TCS-500 Automatic Fax/Modem Test System simulator using IC #14. A pair of Xerox Telecopier 7024 fax machines send and receive all the faxes. (The Telecopier 7024 is a Group 3 9,600-bps fax machine.)

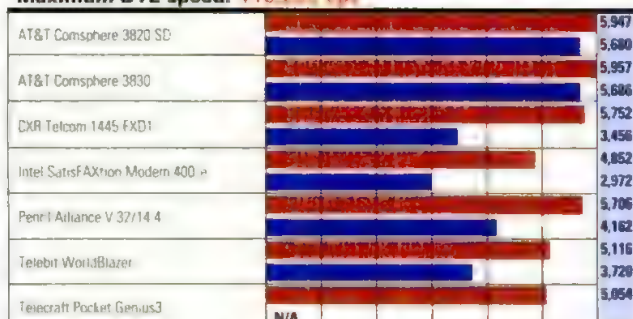
DATA MODEM PERFORMANCE

Protocol Throughput (unidirectional)

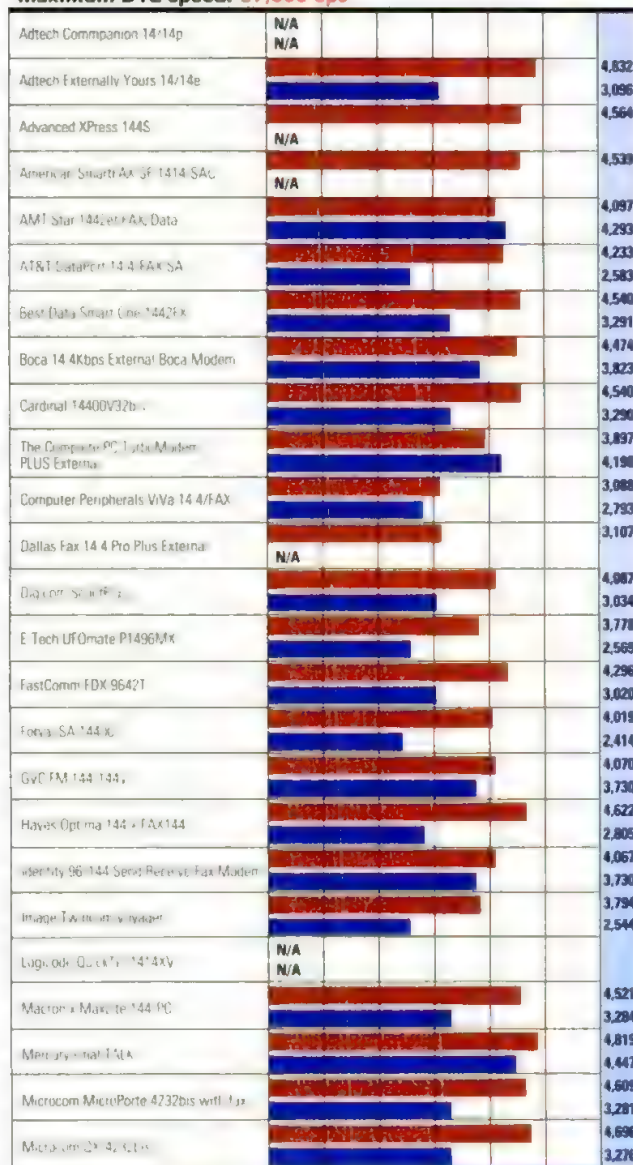
Protocol Throughput (bidirectional)

Characters per second 0 1,000 2,000 3,000 4,000 5,000

Maximum DTE speed: 115,200 cps



Maximum DTE speed: 57,600 cps



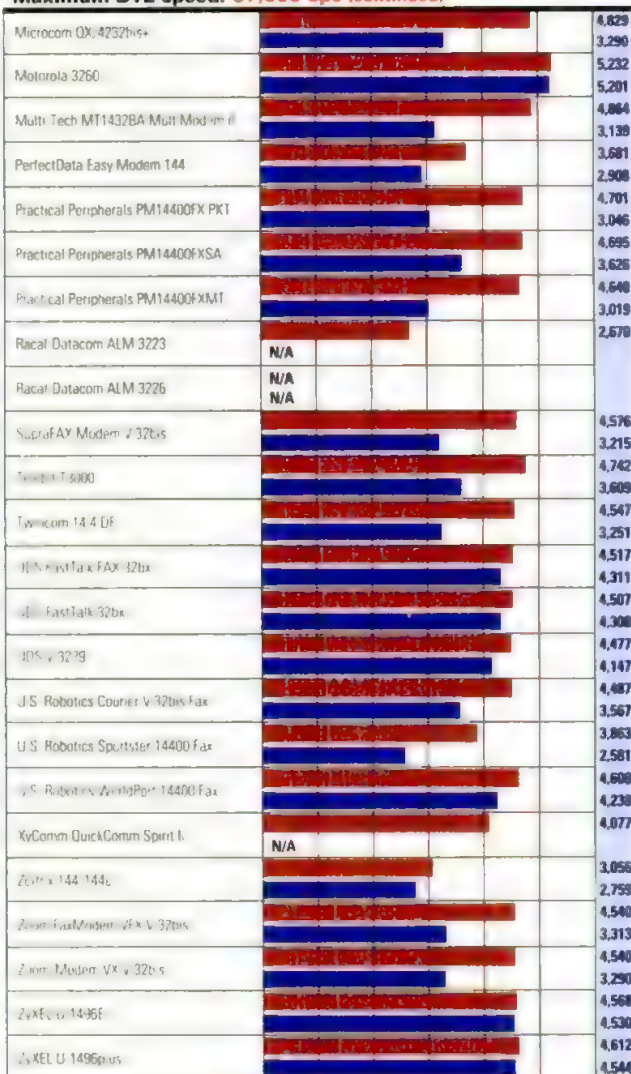
WORST

BEST

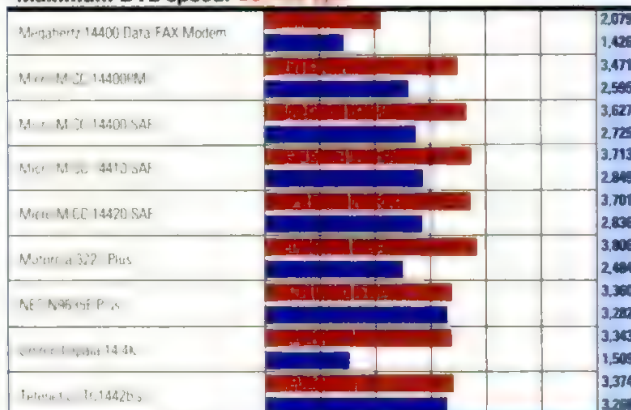
N/A—Not applicable. The product could not complete this test.

Characters per second 0 1,000 2,000 3,000 4,000 5,000

Maximum DTE speed: 57,600 cps (continued)



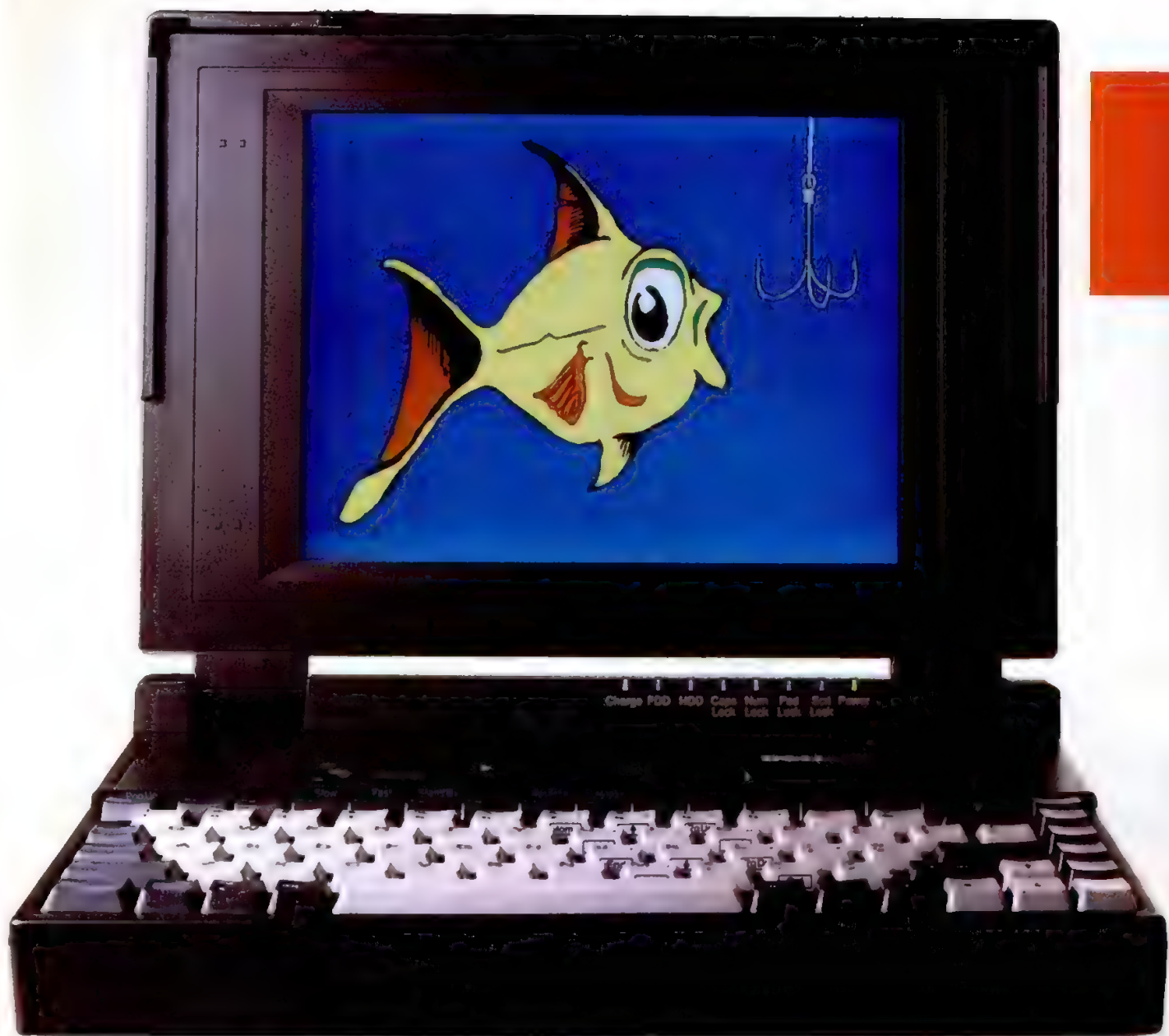
Maximum DTE speed: 38.4 kbps



WORST

BEST

OKAY. WHAT?



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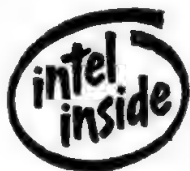
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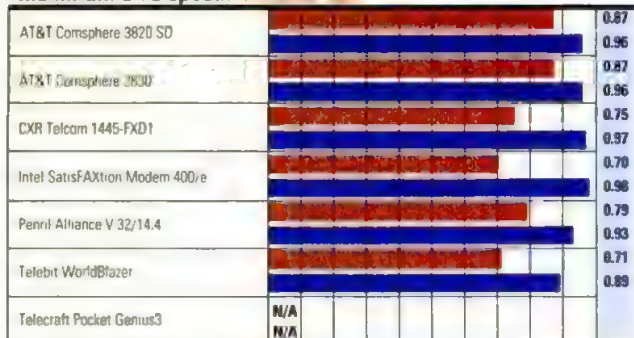
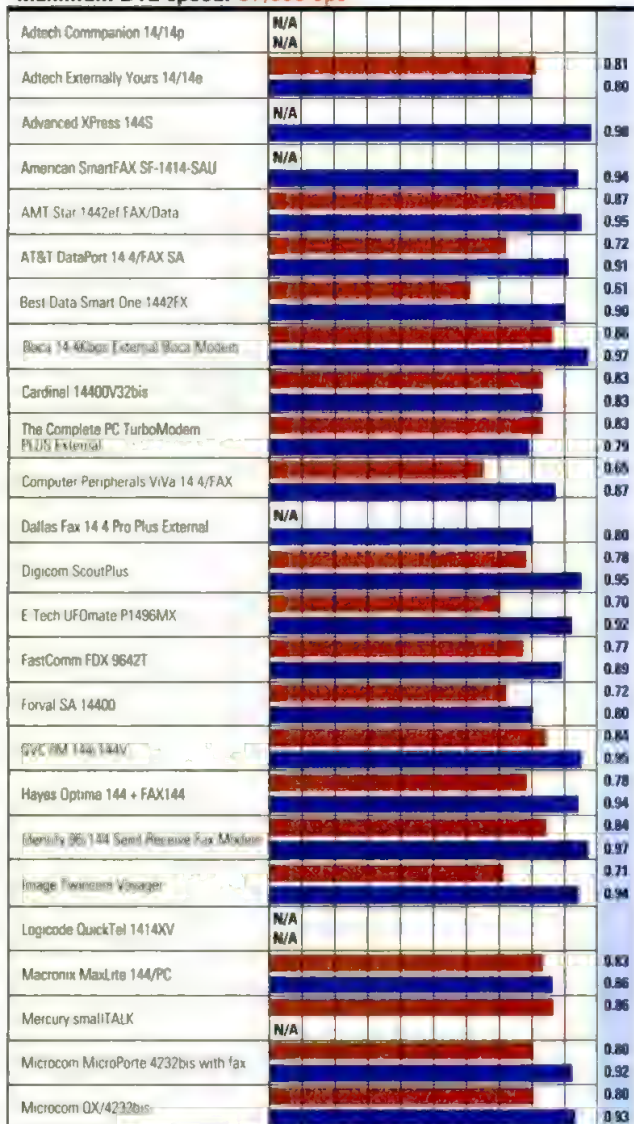
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DATA MODEM PERFORMANCE

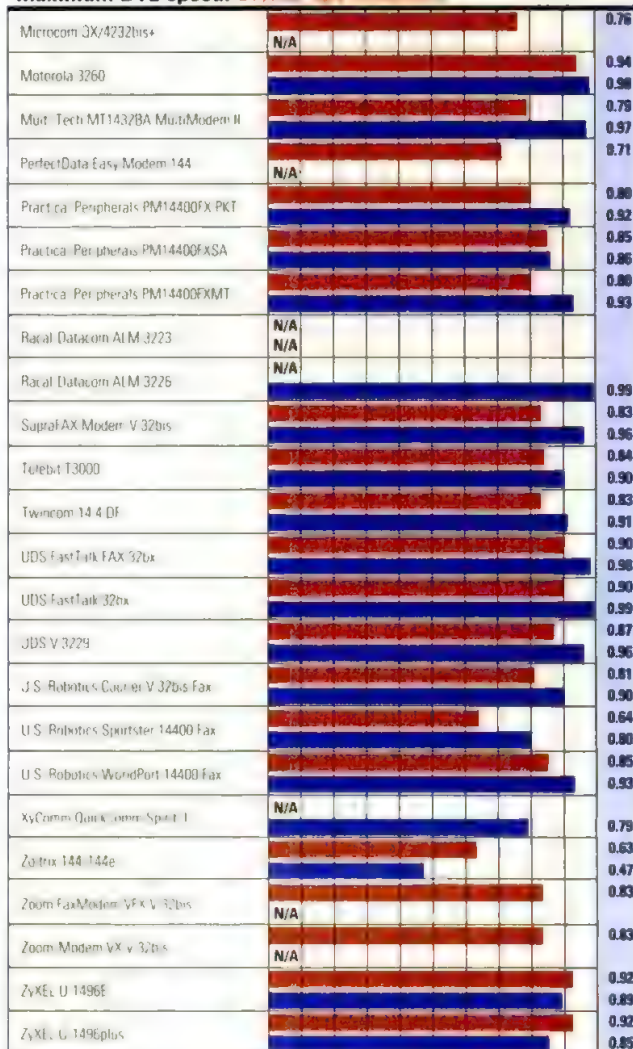
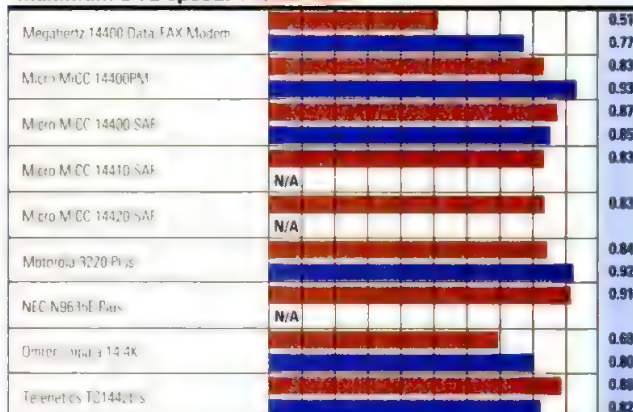
Protocol Ratio
Data Pump Ratio
Ratio ▶ 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9

Maximum DTE speed: 115,200 cps

Maximum DTE speed: 57,600 cps


WORST

BEST

Ratio ▶ 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9

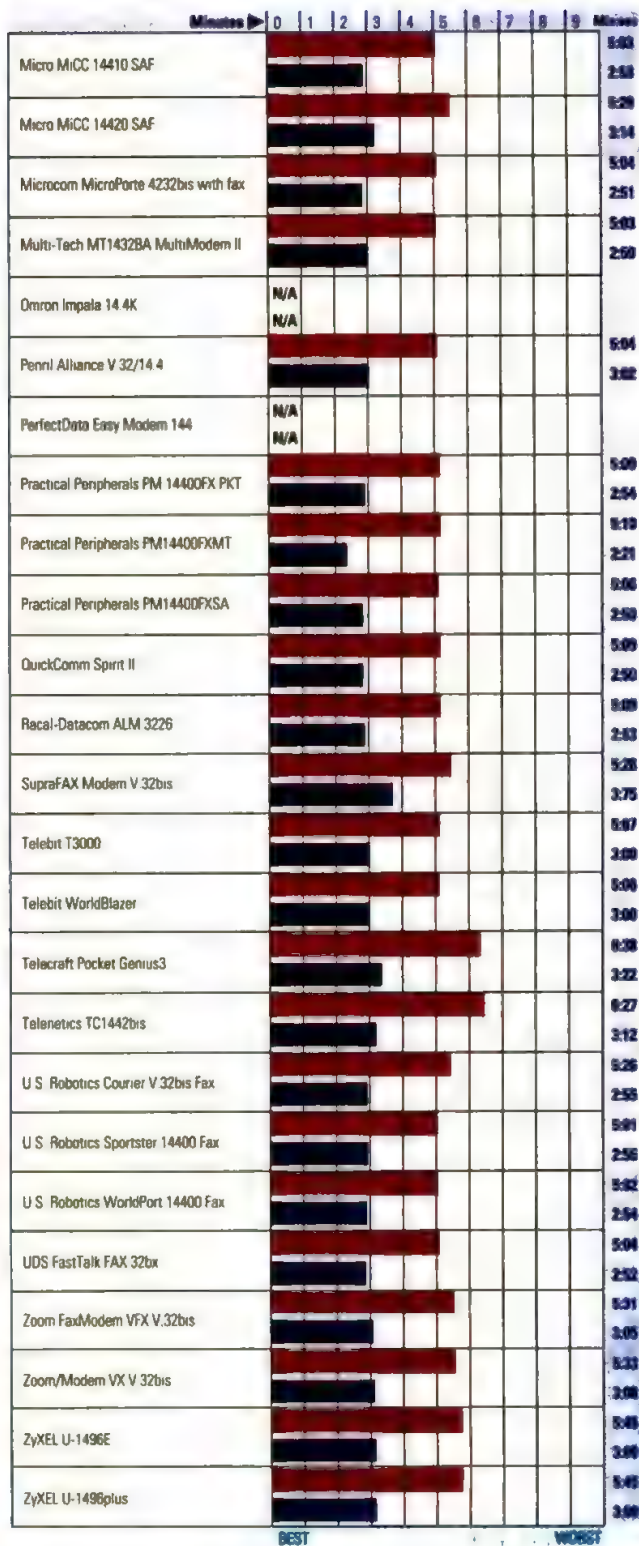
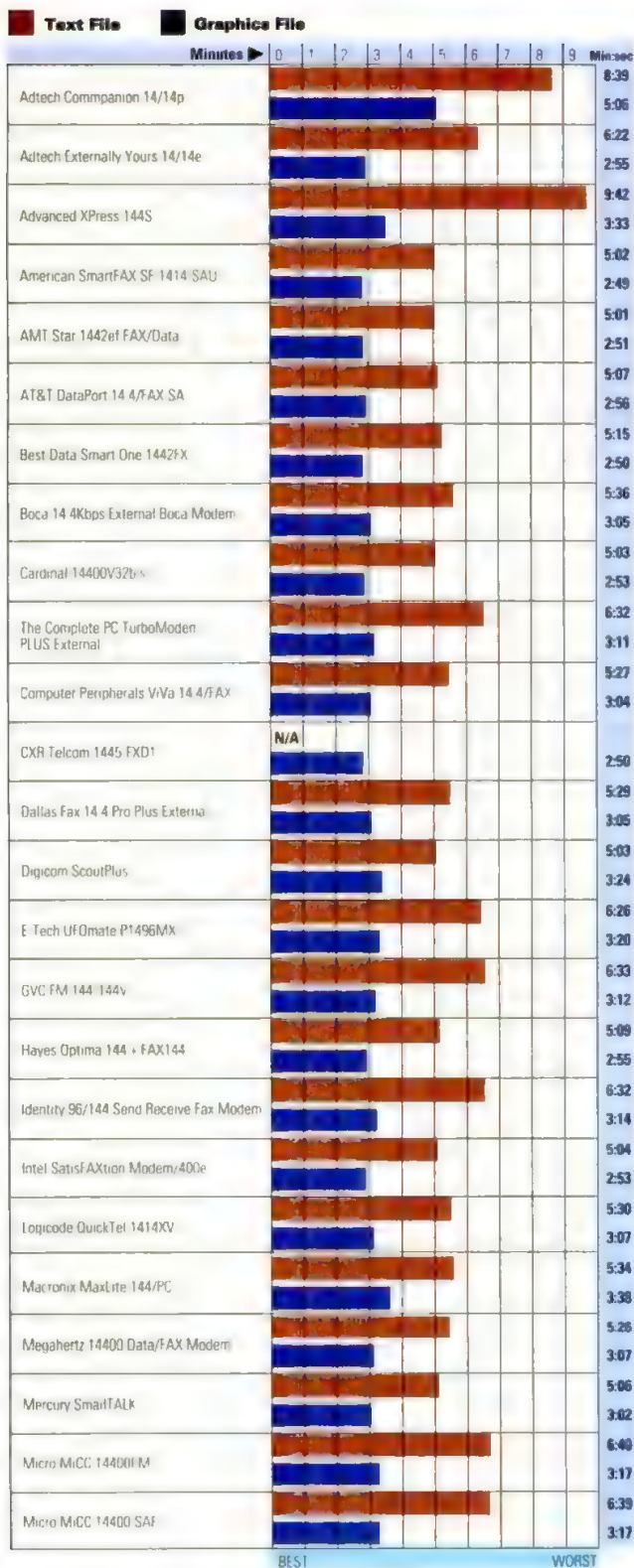
Maximum DTE speed: 57,600 cps (continued)

Maximum DTE speed: 38,400 cps


WORST

BEST

N/A—Not applicable: The product could not complete this test.

FAX MODEM PERFORMANCE



N/A—Not applicable. The product could not complete this test.

look for in each modem, starting with performance. You can use the features table and test results to judge each modem for yourself.

FASTER THAN A SPEEDING...

The best strategy for choosing a modem is probably to narrow the field first by finding the units that meet your performance requirements. You can then choose from among those modems based on features.

You can spot the modems that have serious problems with one or more line conditions or one or more of the test files by looking for zero throughput scores and zero ratios in the performance charts. Any modem with a zero on the unidirectional Protocol Throughput test had trouble even on a best-case line. Modems that failed only the Data Pump test had trouble only on a less-than-best-case line. Modems that failed the Protocol Throughput test had trouble sending one or more of the files in the test suite with total accuracy.

Pinpointing why some modems failed to pass certain tests is far more difficult than simply identifying the failure. Such specific information is not essential for purchasing a modem, but understanding the problems we encountered in testing may help you understand why modems can be so mysterious. Like the FAA trying to understand a plane accident, vendors have to try to reconstruct the crash with special tools before they can identify and fix modem problems. Little evidence is visible, even with the right testing equipment. Moreover, the problems can occur just about anywhere between the serial port and the telephone line.

Despite the difficulty, however, some problems can be tracked to a likely source. Some modems, for example, had what appeared to be a buffer management problem. The first Intel SatisFAX-tion Modem 400/e we saw had a problem with dropping characters received from the computer. A simple chip change fixed this.

With other modems, the problems could not be traced. Advanced Micro Computer System's XPress 144S, American Data Technology's SmartFAX SF-1414-SAU, the Dallas Fax 14.4 Pro Plus External, Telecraft Industries' Pocket

Genius 3, and XyComm Systems' Quickcomm Spirit II showed the same symptoms on some tests, but none of the vendors were able to confirm the cause by the end of the testing period.

Flawed implementation of V.42 error control can also create problems. In fact, this was the second most common problem we found in these modems. The AT&T DataPort 14.4/FAX SA's overall throughput, for example, was limited because in some test runs the modem couldn't negotiate a V.42 connection successfully, which automatically ruled out V.42bis data compression. Yet the modem transferred data without error. Poor V.42 negotiation also took its toll in the

*With Group 3 performance
now near what Group 4
promises, some question
whether Group 4 will ever
be more than a dead end.*

interoperability test. Failure to negotiate a connection on our Data Pump test could be due to data pump or V.42 negotiation issues.

In particular, data pump sensitivity to low levels of impairment prevented a few modems from completing specific tests. Two of Adtech Micro System's Commpanion 14/14p's couldn't talk to each other over Impairment Combination 16 (one of the line conditions for our tests), but the Commpanion 14/14p worked swimmingly over the same line conditions with each of the three host modems. (Even when the data pump worked, however, V.42 didn't.)

For obvious reasons, you're best off with modems that work with every tested line condition. The good news is that the majority of modems covered here fall in that category. But as suggested earlier, significant differences exist among those modems as well, and modems that perform well for one kind of application do not necessarily perform well for others.

Some rules of thumb can help you pick an appropriate modem based on the results you'll find in the modem perfor-

mance tests. (These comments ignore fax performance, which we'll cover later.)

If you spend most of your on-line time transferring uncompressed data in one direction only—as with e-mail systems such as MCI Mail or database systems such as Dialog or Westlaw—pay particular attention to the unidirectional Protocol Throughput results. You'll want to avoid any products that registered much below 4,600 cps. And faster is better.

And if you're transferring uncompressed data, also take a close look at the V.42bis Protocol Ratio. A high number here indicates a modem that not only compresses data well but does so consistently. Keep in mind, however, that the ratios are directly comparable only for modems with a given DTE speed. DTE, or data-terminal equipment, is the generic term for a PC or any other device connected to your modem's serial port. The DTE speed is the connect speed between the modem and the PC or terminal, and the maximum DTE speed varies according to modem design—which is why the results are sorted by DTE speed. Use the V.42bis Protocol Ratio to see how well each modem compresses data; use the Protocol Throughput test to compare modems across the board.

If you spend a significant amount of time transferring already compressed files such as those on a BBS, focus on the results of the Data Pump test. A high value here means that when data is already compressed, you can count on the modem providing consistently fast, and therefore inexpensive, data transfer for any reasonable line condition. If this is your primary communications requirement, you won't want a modem that scores much below 0.90.

For a remote-control program such as Symantec/Peter Norton Group's Norton pcAnywhere, for a LAN-to-LAN bridge between routers, or for other applications that need two-way communications, the bidirectional Protocol Throughput Test is critical. For two-way communications, you won't want a modem that scores much below 4,000 cps on this test. The Protocol Ratio is also important here. But here again, the Protocol Ratios are directly comparable only for modems with the same DTE speed.

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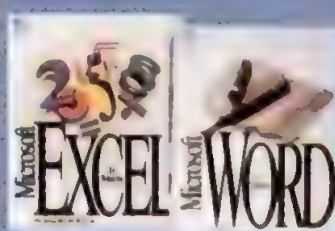
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W11325	Atree for Windows - 3"	\$64

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W07209	MS PowerPoint 3.0 for Win Comp Upgr - 3"	\$118
W07224	Picture Publisher for Windows 3.1 - 3"	\$284
D07080	Presentation Task Force 4.0 - D	\$128

HARDWARE

ACCESSORIES

B09521	Kensington MasterPiece Plus	\$98
B04690	Kensington Notebook Traveler Deluxe Case	\$78
B05284	Targus Premier Leather Notebook Case	\$138

B07754 Targus Universal Notebook Case

ENHANCEMENTS

B07488	1MBx9 70ns for PC (Single)	\$55
B08228	1MBx9 80ns for PC (Single)	\$49
B07816	4MBx9 80 (2 SIMMS per tube)	\$347

STORAGE

B09823	Colorado Jumbo 250 TBI	\$269
B10665	Maxtor MXT™ 120A 130 4MB IDE Int HD 15MS	\$408
B10662	Maxtor MXT™ 213A 213 4MB IDE Int HD 15MS	\$408
B11547	NEC CDR 74 Ext CD ROM Only	\$636
B11538	NEC CDR 84 Int CD ROM Only	\$548

STORAGE MEDIA

B00185	Syquest 44MB Cart	\$60
B00183	Syquest Cart 88MB	\$106

INPUT / OUTPUT

ACCESSORIES

B09522	Kensington Expert Mouse	\$98
D11324	Keystone Trak 101 keyboard	\$168
D07216	Logitech Kidz Mouse	\$49
B09088	Logitech Mouseman Bus Right-hand	\$86
B08620	MS Serial Mouse and PS 2	\$86
D08875	Trackman Portable Trackball	\$69

MODEMS & FAXES

D10541	Practical Modem PM 1-4400EX v.42bis Int	\$226
B04491	Shiva NetModem 1 Thin/BNC	\$1478
B00414	Supra Fax Modem V.42BIS w/o St Cable Ext	\$249
W10514	Ultra HomeOffice Int 14.4 v.42bis	\$294

MONITORS / VIDEO CARDS

B11891	ATI Graphics Ultra Pro w/2 MB (ISA PC)	\$558
B12128	ATI Graphics Ultra - 1MB	\$489
B12116	Hercules Graphics HG210	\$289
B09801	NEC Multimedia 516c Monitor	\$629
B09800	NEC Multimedia 516c Monitor	\$749
B09800	NEC Multimedia 516c Monitor	\$1188
D12946	Spectrum 24 for Windows ISA	\$925
D12947	Spectrum 24 for Windows Local Bus	\$925
B05123	SuperMatch 17" Multimode Color	\$908
B06234	SuperMatch 20" Multimode Color	\$1277

MULTIMEDIA

B05689	ACS300 Computer Spkr Sys w/Sub WFR	\$298
B12536	Creative Labs Discovery 16 Int	\$528
W07862	Encore 2.5 for Windows MPC - D	\$378
W10571	Media Vision CDPC Multimedia Subsystem Ext	\$988
W12528	MediaVision Fusion CD16	\$519
W11936	Midisoft Studio for Windows 3.1 - D	\$168
W11650	MS Windows Sound System WSS	\$198
W07860	Multisound for Win	\$594
B11530	NEC CD Express PC W/CDR 25	\$428
B10692	Pro 16 Multimedia System Int MPC	\$948
B10568	Pro Audio Spectrum 16	\$198
B12527	Pro Audio Studio 16	\$228
B12531	Sound Blaster Pro Deluxe	\$139
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B12129	Sound Blaster 16 ASP	\$239
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PRINTERS

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B12532	Canon BJ-200	\$388
B11660	NEC M95FX Print W/Postscript Fax	\$2075
B05373	NEC SilentWriter M990 Printer	\$924
B12540	Seiko Smart Label Printer Pro	\$248

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Price/Performance Index: V.32bis Modems

The modem with the best Price/Performance Index may not necessarily be the best modem for your particular needs. The Price/Performance Index models only one set of user requirements, in which pricing, data performance, faxing ability, modem interoperability, and clear indicators are important. Other modem strengths that we weighed when awarding Editors' Choices are not considered in this measurement.

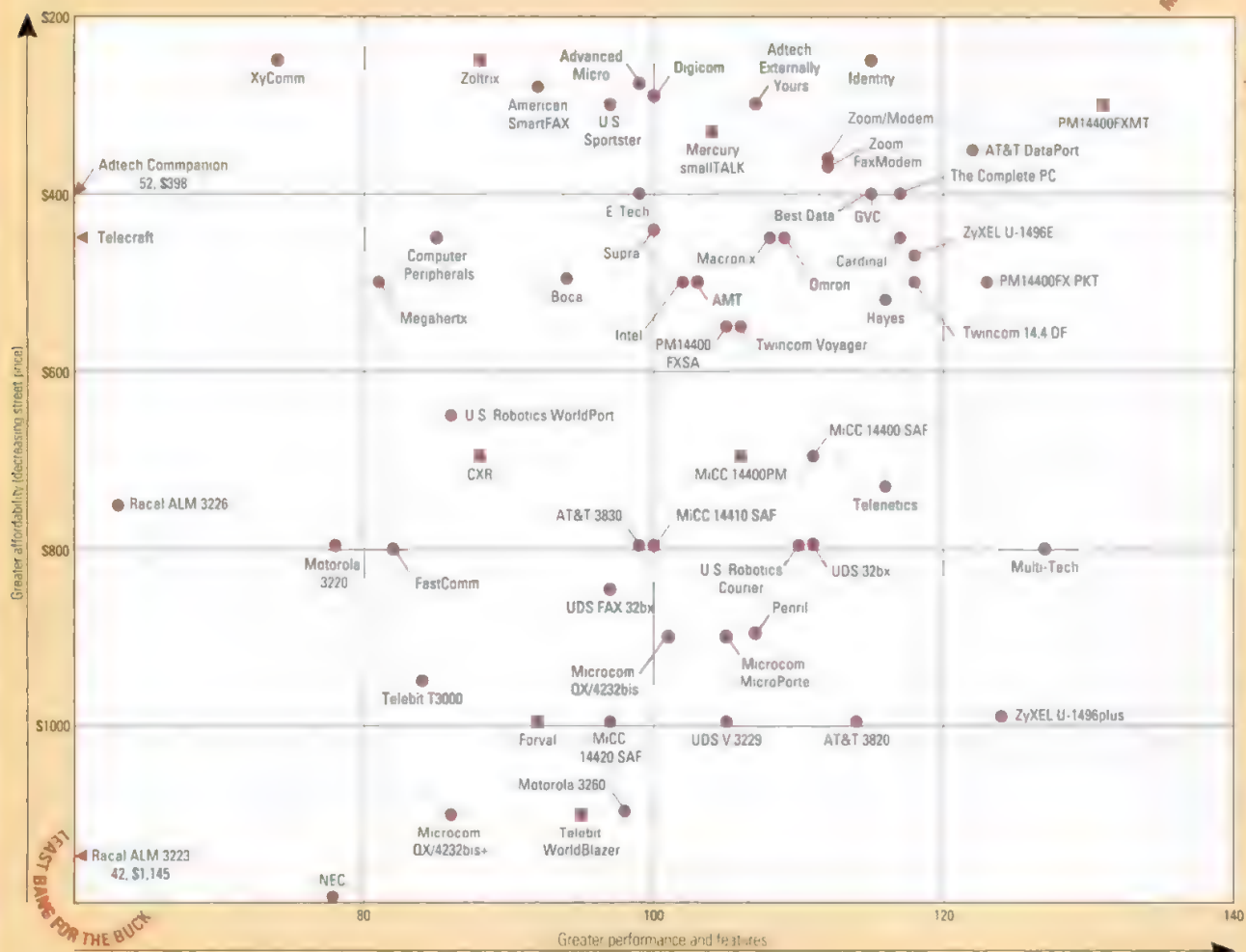
The Practical Peripherals PM14400FXMT offered the best performance for the lowest price. This compact modem has clear status indicators and offers some of the highest performance numbers; it also connected to each of the modems in our interoperability test. This type of showing for \$300 makes this little product an exceptional value.

The AT&T DataPort 14.4/FAX SA, the Identity 96/144 Send Receive Fax Modem, and the Practical Peripherals PM14400FX PKT also offer a good

complement of features—such as clear indicators, speaker and volume control, and fax capability—along with strong performance and, best of all, a low price (around \$300).

Slightly less effective is Advanced Micro Computer System's Xpress 144S and American Data Technology's SmartFax SF-1414-SAU. Both have fewer features and were not as fast as the Practical Peripherals PM14400FXMT, the AT&T DataPort 14.4/FAX SA, or the Identity 96/144 Send Receive Fax Modem, but they both did offer a decent price.

The modems with the lowest Price/Performance Index, the Racal-Datcom ALM 3223 and 3226, each have a Price/Performance ratio 60 percent lower than the average. Adtech Micro Systems' Companion 14/14p has some good features but its performance scores were very poor for a modem with a \$400 price tag.



THE DATA POINTS

Half of the Price/Performance Index is based on the product's overall performance. We take into account the modem's results on the Protocol Throughput test, the Data Pump Ratio test, and the fax performance tests. The remaining 50 percent of the score is derived by weighing the various features that are supported by the modems. We consider whether or not

communications and fax software is included with the unit, what types of indicators are built into the modem, whether or not speaker and volume control is present, the kinds of additional data-modulation methods that are used, and whether or not the modem offers synchronous operation. We base pricing on our tested configuration as listed in the Summary of Features table that follows.

NETWORKING

V.32bis Modems

► SUMMARY OF FEATURES

■—Portable □—Desktop

Products listed in alphabetical order by company

■ = YES □ = NO

	Adtech Micro Systems Inc. Companion 14/14p	Adtech Micro Systems Inc. Externally Yours 14/14e	Advanced Micro Computer System Inc. XPress 144S	American Data Technology Inc. SmartFAX SF-1414-SAU	AMT International Industries Inc. AMT Star 1442ef FAX/Data	AT&T Paradyne AT&T Comsphere 3820 SD
List price (tested configuration)	\$398.00	\$298.00	\$275.00	\$279.00	\$499.00	\$395.00
Communications software included	Phoenix Data for DOS	Phoenix Data for DOS	QuickLink II	COMM90 Lite	QuickLink II	None
Facsimile software included	Phoenix Fax for DOS	Phoenix Fax for DOS	QuickLink II	SmartFax 2C	QuickLink II	None

Physical Characteristics

Dimensions (HWD, in inches)	0.8 x 2.3 x 4	1.3 x 7.0 x 9.3	1.5 x 6.3 x 10	2 x 6 x 9.5	1.8 x 6.1 x 9.5	2.2 x 7.6 x 12
Case style	Pocket	Standard desk phone*	Standard desk phone	Standard desk phone	Standard desk phone	Oversize desk phone
Power switch/Voice-operation switch	■ □	□ □	■ □	■ □	■ ■	■ ■
Volume control	□	□	■	□	□	■
Second phone jack	□	■	■	□	■	■
Distinctive ring for data/voice call	□	□	□	□	□	□
Status indicators	Lights: AA, PWR, RD, SD	Text: AA, CD, DC, EC, MR, OH, RI, TR	Lights: AA, CD, OH, RD, SD, TM, TR	Lights: AA, CD, MR, OH, PWR, RD, SD, TR	Lights: AA, CD, CTS, MNPV42, MR, OH, RD, SD, TR	Lights: CD, EC, MR, OH RD, SD, TR
Speed indicators	None	All speeds (text)	9,600 bps or faster (HS light)	9,600 bps or faster (HS light)	12,000 bps (blinking), all other speeds (steady)	4,800 bps or faster (HS light)

Standards Supported

Additional data modulation methods supported	V.21	V.21, V.23, V.33	Bell 201A, Bell 201C, Bell 208A, V.21, V.23	V.21, V.23	V.21	V.21
Additional command sets supported	None	None	MNP 7, MNP 10	None	None	None
Synchronous operation	□	□	□	■	■	■
Command sets	Subset of Hayes V Series	Superset of Hayes V Series	Matches Hayes V Series	Superset of Hayes V Series	Matches Hayes 2400	Superset of Hayes 2400
Error control and data compression command set	Hayes V Series	Hayes V Series	Microcom	Hayes V Series/Microcom	Microcom	Hayes V Series/Microcom
Data pump manufacturer	Rockwell	Phylon	Rockwell	Rockwell	Rockwell	AT&T
Fax capability	Group 3, V.17	Group 3, V.17	Group 2, Group 3, V.17	Group 3, V.17	Group 2, Group 3, V.17	None
Fax command set	Class 1, Class 2	Class 1	Class 1, Class 2, Class 2.0	Class 1, Class 2	Class 1	None

Technical Support

AT-command reference	■	■	■	■	■	■
Quick-reference card	■	■	■	■	■	■
Background information on communications included	□	□	■	□	□	□
Free support via toll-free number	□	□	□	□	□	■
Warranty	5 years	5 years	5 years	1 year	5 years	2 years

* This unit is not suitable as a platform for a standard telephone

AA—auto-answer enabled, CA—compression active, CD—data carrier detect, CTS—clear to send, EC—error control active, LB—low battery, MNPV42—MNP/V.42 mode,

MR—data set ready, OH—off-hook, PWR—power, RD—receive data, RI—ring indicator, RTS—request to send, SD—send data, SQ—signal quality, TD—transmit data, TM—test mode, TR—data terminal ready.

NETWORKING

V.32bis Modems

CONTINUES



AT&T Paradyne	AT&T Paradyne	Best Data Products Inc.	Boca Research Inc.	Cardinal Technologies Inc.	The Complete PC Inc.	Computer Peripherals Inc.	CXR Telcom Corp.	Digicom Systems Inc.
AT&T Comsphere 3830	AT&T DataPort 14.4/FAX SA	Smart One 1442FX	14.4Kbps External Boca Modem	Cardinal 14400V32bis	TurboModem PLUS External	ViVa 14.4/FAX	CXR Telcom 1445-FXD1	ScoutPlus
\$795.00	\$350.00	\$399.00	\$495.00	\$449.00	\$399.00	\$449.00	\$695.00	\$289.00
None	QuickLink II	QuickLink II	QuickLink II	QuickLink II	CrossTalk	QuickLink II	None	Qmodem Lite
None	QuickLink II	QuickLink II	QuickLink II	QuickLink II	RapidFAX	QuickLink II, WinFax Lite	None	DosFax Lite, WinFax Lite

21x76x12	12x58x85	15x63x95	13x55x74	15x55x96	15x53x95	55x2x58	15x68x115	15x55x9
Oversize desk phone	Standard desk phone	Standard desk phone	Standard desk phone*	Standard desk phone	Standard desk phone	Mini tower phone	Oversize desk phone	Standard desk phone*
Lights CD, CTS, RMNPV42, RD, D, SQ, TR, Text A, EC, LB, MR, OH, RI, TM	Lights CD, CTS, EC, OH, PWR, RD, RTS, SQ, TD, TR	Lights AA, CD, OH, RD, RI, SD, TM, TR	Lights AA, CD, OH, RD, SD, TM, TR	Lights AA, CD, RD, RI (blinking), SD, TR	Lights AA, CD, MR, OH, RD, RI (blinking), SD, TM, TR	Icons CD, OH, MR, RD, RI, SD, TR	Lights CD, OH, RD, RI, TD, TR	Lights AA, CD, CTS, EC, OH, RD, SD, TR
11 speeds (text)	None	None	4,800 bps or faster (HS light)	4,800 bps or faster (HS light)	4,800 bps or faster (HS light)	4,800 bps or faster (icon)	14,400 (steady), all other speeds (blinking)	2,400 bps or faster (HS light)

V 21	V 21, V 23	V 21, V 23	V 21	V 21	V 21, V 23	V 21	V 21, V 23	None
None	None	None	None	None	None	None	None	None
■	■	■	□	■	■	■	■	[]
Superset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes V Series	Superset, subset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes V Series	Matches Hayes V Series	Superset of Hayes 2400	Superset of Hayes V Series
Hayes V Series/Microcom	Hayes V Series/Microcom	Hayes V Series	Microcom	Microcom	Hayes Ultra	Microcom	Proprietary	Proprietary
AT&T	AT&T	Rockwell	Rockwell	Rockwell	Rockwell	Rockwell	AT&T	Proprietary
None	Group 3, V 17	Group 2, Group 3, V.17	Group 3, V 17	Group 3, V 17	Group 3, V 17	Group 3, V 17	Group 3	Group 3
None	Class 2	Class 2	Class 1, Class 2	Class 1, Class 2	Class 2	Class 2	Class 1, Class 2	Class 1

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2 years	2 years	2 years	5 years	1 year	7 years	5 years	1 year	5 years

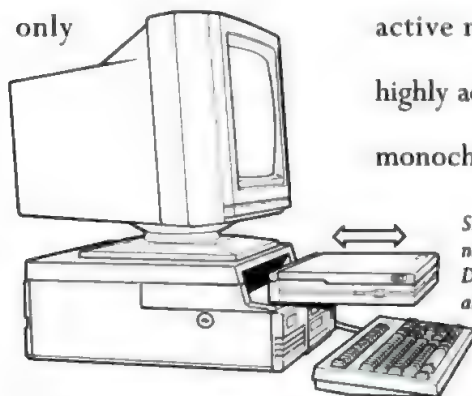
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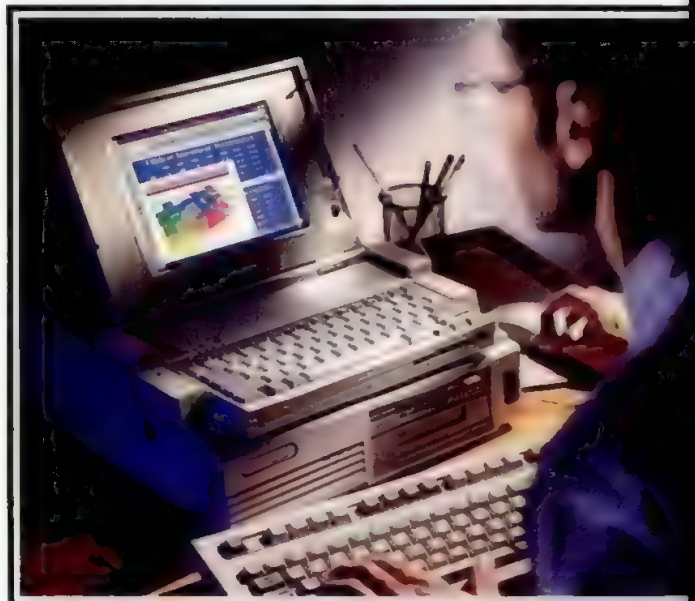


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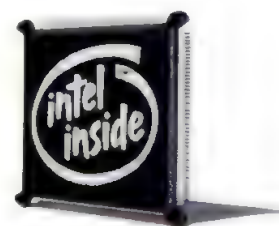
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4/25 starts under \$1,999

486SX chip in comparably priced notebooks, this one has an integrated coprocessor. And it runs more efficiently, helping to extend battery life.

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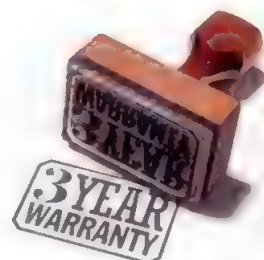
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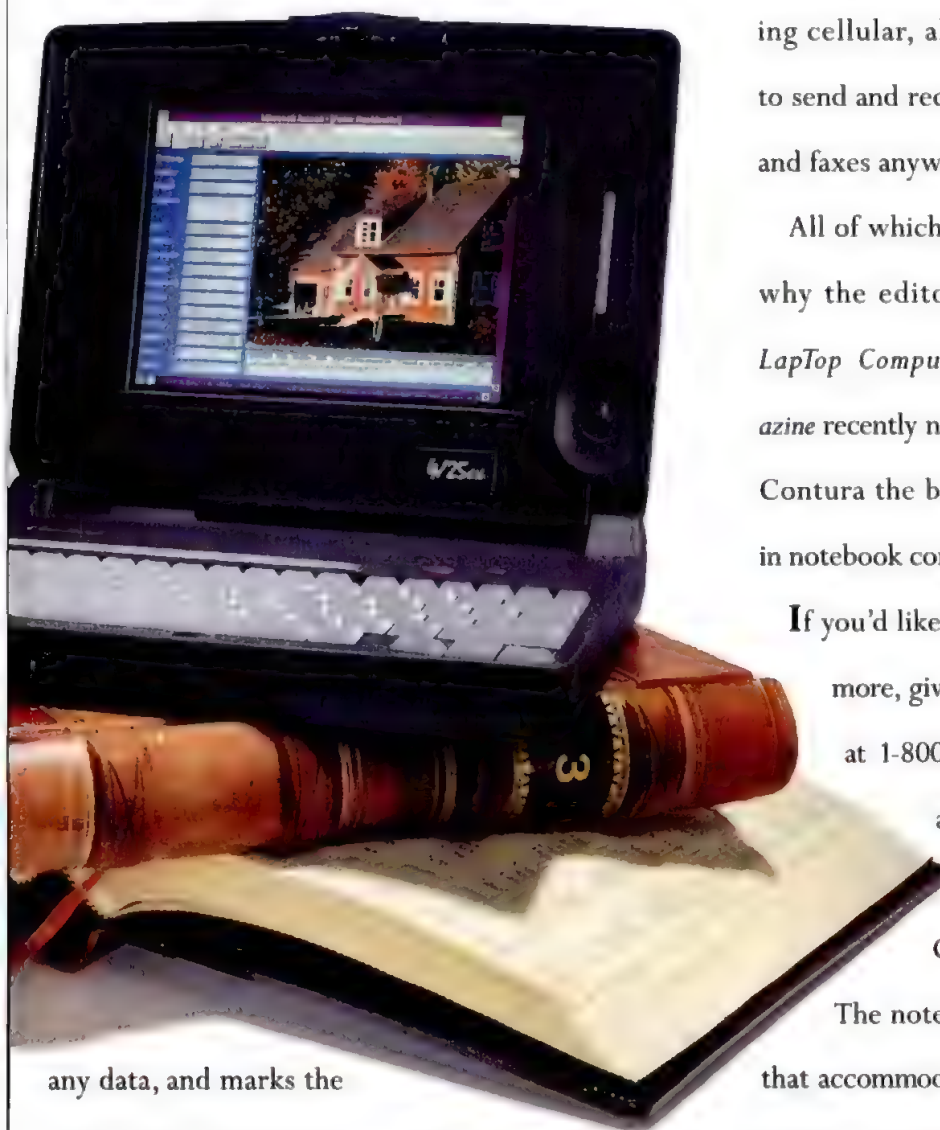
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any data, and marks the
spot where you left off.
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up again, it automatically

also come with
an external battery charg-
er that lets you recharge



*Results based on tests run by Compaq using PC Magazine Labs WinBench Release 3.1 as compared to results of Dec. 22, 1992 issue of PC Magazine. **This service provided by Contracted Service Providers and may not be available in certain geographic locations. Certain restrictions and exclusions apply. Monitors, battery packs and certain options are covered by a one-year warranty. For further details on our limited warranty, contact the Compaq Customer Support Center

CIRCLE 308 ON READER SERVICE CARD

NETWORKING

V.32bis Modems

► SUMMARY OF FEATURES

 **Portable**
 **Desktop**

Products listed in alphabetical order by company.

■ = YES □ = NO

	E-Tech Research Inc. E-Tech UFOmate P1496MX	FastComm Communications Corp. FastComm FDX 9642T	Forval America Inc. Forval SA 14400	GVC Technologies Inc. GVC FM 144/144V	Hayes Microcomputer Products Inc. Optima 144 + FAX144	Identity Systems Technology Inc. Identity 96/144 Send Receive Fax Modem
List price (tested configuration)	\$399.00	\$799.00	\$995.00	\$399.00	\$519.00	\$249.00
Communications software included	QuickLink II	None	Communications by CrossTalk	QuickLink II	Smartcom EZ	QuickLink II
Facsimile software included	QuickLink II	None	None	QuickLink II	Smartcom FAX	QuickLink II

Physical Characteristics

Dimensions (HWD, in inches)	1.3 x 3.6 x 4.5	1.8 x 6.5 x 10	2 x 8 x 10	1.8 x 5.5 x 9.5	1.8 x 5.5 x 9.5	1.8 x 5.5 x 9.5
Case style	Oversize pocket	Standard desk phone	Wide desk phone (horizontal)*, mini-tower (vertical)	Standard desk phone	Standard desk phone	Standard desk phone
Power switch/Voice-operation switch	■ □	■ ■	□ ■	■ □	■ □	■ □
Volume control	□	■	□	□	□	□
Second phone jack	■	■	■	■	■	■
Distinctive ring for data/voice call	■	□	□	□	□	■
Status indicators	Lights: CD, LB, RD, SD	Lights: AA, CD, CTS, EC, MR, RD, RTS, SD, TR	Text: AA, CA, CD, EC, MNPV42, MR, OH, RD, RI, SD, TR	Lights: AA, CD, MR, OH, RD, RI (blinking), SD, TM, TR	Lights: AA, CD, MR, OH, RD, RI (blinking), SD, TM (blinking), TR	Lights: AA, CD, MR, OH, RD, RI (blinking), SD, TM, TR
Speed indicators	None	1,200 bps (LS light), 2,400 bps or faster (HS light)	All speeds (text)	4,800 bps or faster (HS light)	4,800 bps or faster (HS light)	4,800 bps or faster (HS light)

Standards Supported

Additional data modulation methods supported	V.21, V.23	V.21, V.23	None	V.21, V.23	V.21	V.21, V.23
Additional command sets supported	None	None	None	None	None	None
Synchronous operation	□	■	■	■	■	■
Command sets	Subset of Hayes V Series	Superset of Hayes 2400	Superset of Hayes V Series	Superset, subset of Hayes 2400	Superset of Hayes V Series	Subset of Hayes V Series
Error control and data compression command set	Hayes V Series	Proprietary	Microcom	Microcom	Hayes Optima	Hayes V Series
Data pump manufacturer	AT&T	AT&T	Cornel	Rockwell	AT&T	Rockwell
Fax capability	Group 3	None	None	Group 2, Group 3, V.17	Group 3, V.17	Group 3
Fax command set	Class 2	None	None	Class 2	Class 1	Class 2.0

Technical Support

AT-command reference	■	■	■	■	■	■
Quick-reference card	■	■	■	■	□	■
Background information on communications included	□	■	□	□	■	□
Free support via toll-free number	■	■	□	□	□	■
Warranty	2 years	2 years	5 years	5 years	2 years	1 year

* This unit is not suitable as a platform for a standard telephone

AA—auto-answer enabled, CA—compression active, CD—data carrier detect, CTS—clear to send, EC—error control active, LB—low battery, MNPV42—MNP/V 42 mode,

MR—data set ready, OH—off-hook, PWR—power, RD—receive data, RI—ring indicator, RTS—request to send, SD—send data, SQ—signal quality, TD—transmit data, TM—test mode, TR—data terminal ready

NETWORKING
V.32bis Modems

CONTINUES

Intel Corp	Macronix Inc	Megahertz Corp	Mercury Technologies	Micro Integrated Communications Corp.	Micro Integrated Communications Corp.	Micro Integrated Communications Corp.	Micro Integrated Communications Corp.	Microcom Inc
ntisFAXtion odem 400/e	MaxLite 144/PC	14400 Data/FAX Modem	smallITALK	Micro Integrated Communications Corp. MiCC 14400PM	Micro Integrated Communications Corp. MiCC 14400 SAF	Micro Integrated Communications Corp. MiCC 14410 SAF	Micro Integrated Communications Corp. MiCC 14420 SAF	Microcom MicroPorte 4232bis with fax
\$499.00	\$449.00	\$499.00	\$329.00	\$695.00	\$695.00	\$795.00	\$995.00	\$899.00
CrossTalk mmunicator	Comit	MTEZ with ExpressFax	QuickLink II	QuickLink II	QuickLink II	QuickLink II	QuickLink II	None
el FAXability	WinFax	Eclipse FAX SE	QuickLink II	QuickLink II	QuickLink II	QuickLink II	QuickLink II	DosFax Lite, WinFax Lite
3 x 5.5 x 9.3	11 x 2.9 x 4.7	1 x 2 x 3.3	1 x 2.3 x 4.8	1 x 2.8 x 5	2.8 x 6.5 x 10.5	1.8 x 6.3 x 10.5	1.5 x 6.3 x 12	1.5 x 2.8 x 4.6
Standard desk phone	Pocket	Pocket	Pocket	Pocket	Standard desk phone	Standard desk phone	Oversize desk phone	Oversize pocket
■ □	■ □	□ □	■ □	■ □	■ □	□ □	□ □	■ □
□	□	■	□	□	□	□	□	□
■	□	□	■	■	■	■	■	■
□	□	□	□	□	□	□	□	□
Lights: AA, CA (linking), CD, MR, OH, RD, SD, TR	Lights: LB, PWR	None	Lights: LB, PWR	Lights: CD, LB	Lights: AA, CD, MR, OH, RD, SD, TR	Lights: AA, CD, MR, OH, RD, SD, TR	Text: AA, CTS, MR, OH, RD, RI, RTS, SD, SQ, TM, TR	Lights: LB, PWR, TR
1200 bps (green blinking), 4,800 bps (yellow), 9,600 bps (yellow blinking), 9,600 bps (red), 12,000 bps or faster (red blinking)	None	None	None	None	9,600 bps or faster (HS light)	9,600 bps or faster (HS light)	All speeds (text)	1,200 bps or faster (HS light)
V.23	V.21	V.21, V.23	V.21, V.23	V.21, V.23	V.21, V.23	V.21, V.23	V.21, V.23	V.21
None	None	None	None	None	None	None	None	None
■	□	□	■	□	■	■	■	□
Matches Hayes V Series	Matches Hayes V Series	Superset subset of Hayes V Series	Matches Hayes V Series	Superset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes V Series
Microcom	Hayes V Series	Microcom	Hayes V Series/ Microcom	Microcom	Microcom	Microcom	Microcom	Microcom
Rockwell	Rockwell	AT&T	AT&T	Rockwell	Rockwell	Intel	Rockwell	Rockwell
Group 3	Group 3, V.17	Group 3, V.17	Group 3, V.17	Group 3, V.17	Group 3, V.17	Group 3, V.17	Group 3	Group 3
Class 1	Class 2	Class 1	Class 1, Class 2	Class 2	Class 2	Class 2	Class 2	Class 1
■	■	□	■	■	■	■	■	■
■	□	■	■	□	□	□	□	□
□	□	□	□	□	□	□	□	□
□	■	■	■	□	□	□	□	□
years parts only	5 years	5 years	5 years	2 years	2 years	2 years	2 years	1 year

NETWORKING

V.32bis Modems

► SUMMARY OF FEATURES

■ — Portable □ — Desktop

Products listed in alphabetical order by company

■ = YES □ = NO

	Microcom Inc.	Microcom Inc.	Motorola Codex	Motorola Codex	Multi-Tech Systems Inc.	NEC America Inc.
	Microcom QX/4232bis	Microcom QX/4232bis+	Motorola 3220 Plus	Motorola 3260	Multi-Tech MT1432BA MultiModem II	NEC N9635E Plus
List price (tested configuration)	\$899.00	\$1,099.00	\$795.00	\$1,095.00	\$799.00	\$1,199.00
Communications software included	None	None	None	None	MultiExpress Communications Software	None
Facsimile software included	None	None	None	None	MultiExpress Fax	None

Physical Characteristics

Dimensions (HWD, in inches)	1.8 x 6.5 x 10.7	1.8 x 6.5 x 10.7	1.8 x 6.8 x 10	2.5 x 6.5 x 9.8	2.8 x 6.3 x 9.3	2 x 8 x 12
Case style	Oversize desk phone	Oversize desk phone	Standard desk phone*	Standard desk phone*	Standard desk phone	Wide desk phone
Power switch/Voice-operation switch	■ ■	■ ■	■ □	■ □	■ ■	■ ■
Volume control	■	■	□	□	■	■
Second phone jack	■	■	■	■	■	■
Distinctive ring for data/voice call	□	□	□	□	□	□
Status indicators	Lights: OH, PWR, RD, SD, TM, TR	Lights: OH, PWR, RD, SD, TM, TR	Lights: CD, OH, RI (blinking), SD, TR	Lights: CD, MR, OH, RD, RI (blinking), SD, TR. Text: CA, CTS, EC, MNPV42, RTS, SQ, TM	Lights: CA (blinking), CD, EC, OH, RD, SD, TR	Lights: CD, EC, OH, RD, SD, TM, TR
Speed indicators	1,200–2,400 bps (red blinking), 4,800 bps (green), 7,200 bps or faster (green blinking)	1,200–2,400 bps (red blinking), 4,800 bps (green), 7,200 bps (green), 9,600 bps or faster (green blinking)	None	All speeds (text)	1,200 bps, 2,400 bps, 4,800 bps, 9,600 bps, 12,000 bps, 14,400 bps (lights)	1,200 bps, 2,400 bps, 4,800 bps, 9,600 bps, 14,400 bps (lights)

Standards Supported

Additional data modulation methods supported	V.21	V.21, V.23	None	V.21	None	None
Additional command sets supported	None	None	None	None	None	None
Synchronous operation	■	■	■	■	■	□
Command sets	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes 1200	Superset of Hayes 2400
Error control and data compression command set	Microcom	Microcom	Hayes 2400	Hayes 2400	Proprietary	Microcom
Data pump manufacturer	Rockwell	Rockwell	Motorola	Motorola	AT&T	Rockwell
Fax capability	None	None	None	None	Group 3, V.17	None
Fax command set	None	None	None	None	Class 2	None

Technical Support

AT-command reference	■	■	■	■	■	■
Quick-reference card	■	■	■	■	■	□
Background information on communications included	■	□	□	□	□	□
Free support via toll-free number	□	□	■	■	■	■
Warranty	1 year	1 year	2 years	2 years	5 years	1 year

* This unit is not suitable as a platform for a standard telephone

AA—auto-answer enabled, CA—compression active, CD—data carrier detect, CTS—clear to send, EC—error control active, LB—low battery, MNPV42—MNP/V 42 mode,

MR—data set ready, OH—off-hook, PWR—power, RD—receive data, RI—ring indicator, RTS—request to send, SD—send data, SQ—signal quality, TD—transmit data, TM—test mode, TR—data terminal ready

NETWORKING

V.32bis Modems

CONTINUES



Omron Office Automation Products Inc. mpala 14.4K	Penril DataComm Networks Alliance V.32/14.4	Practical Peripherals Inc. Practical Peripherals PM14400FXMT	Practical Peripherals Inc. Practical Peripherals PM14400FX PKT	Practical Peripherals Inc. Practical Peripherals PM14400FXSA	Racal-Datacom Inc. ALM 3223	Racal-Datacom Inc. ALM 3226	Supra Corp SupraFAX Modem V.32bis	Telebit Corp Telebit T3000
\$449.00	\$895.00	\$299.00	\$499.00	\$549.00	\$1,145.00	\$750.00	\$439.95	\$949.00
None	None	QuickLink II	QuickLink II	QuickLink II	None	None	COMit	None
exMaster, WIN Lite	None	QuickLink II	QuickLink II	QuickLink II	None	None	FaxTalk Plus, WinFax Lite	None

1.4 x 6.6 x 9.8	2.5 x 9.7 x 10.1	1 x 4.5 x 6.8	1.1 x 2.3 x 3.9	5 x 3 x 10.3	1.5 x 5.8 x 10.3	0.9 x 2.6 x 5.5	1.3 x 4.6 x 6.6	2.4 x 8.5 x 13
Standard desk phone	Wide desk phone	Undersized	Two-piece pocket portable	Mini-tower	Standard desk phone	Oversize pocket	Undersized	Wide desk phone
■ □	■ ■	■ □	■ □	■ □	□ □	■ □	■ □	■ ■
■	■	■	□	□	□	□	□	□
■	■	■	■	■	□	■	■	■
□	□	□	□	□	■	■	□	□
Lights: AA, CA, CTS, (blinking), D, EC, MR, OH, PWR, RD, RI (blinking), RTS, SD	Text: CD, CTS, MR, OH, RD, RI, RTS, SD, SQ, TM, TR	Lights: AA, CD, MR, OH, RD, RI (blinking), SD, TR	Lights: AA, CD, MR, OH, RD, SD, TR	Lights: AA, CD, CTS, EC, OH, PWR, RD, RTS, SD, TR Text CA, MNPV42, MR, OH, RI, RTS, SQ, TM	Text: CD, CTS, MR, OH, RD, RI, RTS, SD, SQ, TM, TR	Lights: CD, LB, RD, SD	Lights: RD, SD Text AA, CA, CD, EC, MR, TM	Lights: CD, CTS, EC, MR, OH, RD, RTS, SD, TM (blinking), TR
200-2,400 bps steady, 4,800 bps or faster (blinking)	All speeds (text)	2,400 bps or faster (HS light)	2,400 bps or faster (HS light)	All speeds (text)	All speeds (text)	None	All speeds (text)	9,600 bps or faster (HS light)

V.21	Bell 208A, V.21, V.23, V.33	V.21	V.21	V.21	Bell 208A, V.21, V.23, V.33	V.21	V.21	V.21, V.23
None	None	None	None	None	None	MNP 10	None	None
■	■	■	□	■	■	■	■	■
Subset of Hayes V Series	Superset of Hayes 2400	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes 2400	Matches Hayes V Series
Hayes V Series	Proprietary	Hayes V Series	Hayes V Series	Hayes V Series	Microcom	Microcom	Microcom	Hayes V Series
Rockwell	Penril DataComm Networks	Rockwell	AT&T	AT&T	Toshiba	Rockwell	Rockwell	Telebit
Group 3	Group 3, V.17	Group 3, V.17	Group 3, V.17	Group 3, V.17	None	Group 3, V.17	Group 3, V.17	Group 3
Class 2.0	Class 1, Class 2	Class 1, Class 2	Class 1, Class 2	Class 1, Class 2	None	Class 1, Class 2	Class 1, Class 2	Class 2

■	■	■	■	■	■	■	■	■
■	□	■	■	■	□	■	□	■
□	□	■	□	□	□	□	□	□
□	■	□	□	□	■	■	■	■
1 year	2 years	Lifetime	Lifetime	Lifetime	2 years	2 years	5 years	90 days

NETWORKING

V.32bis Modems

► SUMMARY OF FEATURES

 **Portable**
  **Desktop**

Products listed in alphabetical order by company

☒ = YES
 ☐ = NO

	Telebit Corp. Telebit WorldBlazer	Telecraft Industries Inc. Pocket Genius3	Telenetics Corp. Telenetics TC1442bis	Twincom Twincom 14.4 DF	Twincom Twincom Voyager	U.S. Robotics Inc. Courier V.32bis Fax
List price (tested configuration)	\$1,099.00	\$499.00	\$729.00	\$499.00	\$549.00	\$795.00
Communications software included	None	QuickLink II	DataExpress	QuickLink II	QuickLink II	None
Facsimile software included	None	QuickLink II	FacsExpress	QuickLink II	QuickLink II	WinFax Lite

Physical Characteristics

Dimensions (HWD, in inches)	2.4 x 8.5 x 13	1 x 2.3 x 4.8	1.4 x 5.3 x 9.8	1.5 x 5.5 x 9	1.1 x 3.8 x 4.5	1.5 x 6.3 x 10.3
Case style	Wide desk phone	Pocket	Standard desk phone	Standard desk phone	Oversize pocket	Standard desk phone*
Power switch/Voice-operation switch	☐ ☒	☒ ☐	☐ ☒	☒ ☐	☒ ☐	☒ ☒
Volume control	☐	☐	☐	☐	☐	☒
Second phone jack	☐	☐	☒	☒	☒	☒
Distinctive ring for data/voice call	☐	☐	☐	☐	☐	☐
Status indicators	Lights: CD, CTS, EC, MR, OH, RD, RTS, SD, TM (blinking), TR	Icons: LB, PWR	Lights: AA, CD, EC, MR, OH, RD, RI (blinking), SQ (blinking), TD, TR	Lights: AA, CD, OH, PWR, RD, SD, TM, TR	Lights: CD, LB, RD, SD	Lights: AA, CD, CTS, EC, FAX, MR, OH, RD, RTS, TR
Speed indicators	9,600 bps or faster (HS light)	None	9,600 bps or faster (HS light)	4,800 bps or faster (HS light)	None	4,800 bps or faster (HS light)

Standards Supported

Additional data modulation methods supported	V.21, V.23	V.21, V.23	Bell 201A, Bell 201C, Bell 208A, V.21, V.23	V.21	V.21, V.23	V.21, V.23
Additional command sets supported	None	None	None	None	None	None
Synchronous operation	☒	☒	☒	☒	☐	☒
Command sets	Superset of Hayes V Series	Superset of Hayes V Series	Matches Hayes V Series	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes 2400
Error control and data compression command set	Hayes V Series	Microcom	Microcom	Hayes V Series/Microcom	Hayes V Series/Microcom	Proprietary
Data pump manufacturer	Telebit	AT&T	Rockwell	Rockwell	AT&T	U.S. Robotics
Fax capability	Group 3	Group 3, V.17	Group 2, Group 3, V.17	Group 3, V.17	Group 3	Group 3
Fax command set	Class 2	Class 1, Class 2	Class 2	Class 1, Class 2	Class 2	Class 1

Technical Support

AT-command reference	☒	☒	☒	☒	☒	☒
Quick-reference card	☒	☐	☐	☒	☒	☒
Background information on communications included	☐	☐	☐	☐	☐	☐
Free support via toll-free number	☒	☐	☐	☐	☐	☒
Warranty	90 days	5 years	1 year	2 years; 5 years chip set	2 years; 5 years chip set	2 years

* This unit is not suitable as a platform for a standard telephone

AA—auto-answer enabled, CA—compression active, CD—data carrier detect, CTS—clear to send, EC—error control active, LB—low battery, MNPV42—MNP/V 42 mode,

MR—data set ready, OH—off-hook, PWR—power, RD—receive data, RI—ring indicator, RTS—request to send, SD—send data, SQ—signal quality, TD—transmit data, TM—test mode, TR—data terminal ready

NETWORKING

V.32bis Modems

CONTINUES

U.S. Robotics Inc. Sportster 14400 Fax	U.S. Robotics Inc. WorldPort 14400 Fax	UDS Motorola FastTalk 32bx	UDS Motorola FastTalk FAX 32bx	UDS Motorola UDS V.3229	XyComm Systems Inc. QuickComm Spirit II	Zoltrix Inc. Zoltrix 144/144e	Zoom Telephonics Inc. Zoom FaxModem VFX V.32bis
\$299.00	\$649.00	\$795.00	\$845.00	\$995.00	\$249.00	\$249.00	\$369.00
None	CrossTalk Communicator	None	None	None	Qmodem	BitCom	MTEZ Express
WinFax Lite	WinFax Lite	None	FaxTalk Plus	None	DosFax Lite, WinFax Lite	BitFax	Hot Fax, MTEZ Express, WinFax Lite
1.8 x 5 x 6.5	1 x 2.8 x 4.5	1.5 x 6 x 9.5	1.5 x 6 x 9.5	2.5 x 7 x 9.6	1.5 x 5.5 x 9	1.3 x 4.8 x 5.8	1.6 x 6.1 x 8.5
Undersized	Pocket	Standard desk phone	Standard desk phone	Standard desk phone*	Standard desk phone*	Undersized	Standard desk phone
■ □	□ □	■ ■	■ ■	■ ■	■ □	■ ■	■ □
■	□	■	■	■	□	□	■
■	■	■	■	■	□	■	■
□	□	□	□	■	□	□	□
Lights: AA, CD, CTS, EC, FAX, OH, RD, RTS, SD, TR	Lights: CD, EC (blinking), LB	Lights: CD, EC, MR, OH, RD, RI (blinking), SD, TR	Lights: CD, EC, MR, OH, RD, RI (blinking), SD, TR	Lights: CD, CTS, RD, RTS, SD, SQ. Text: CA, EC, MNPV42, MR, OH, RI, TM, TR	Lights: AA, CD, CTS, EC, MR, OH, RD, SD, TR	Lights: AA, CD, MR, OH, PWR, RD, RI (blinking), SD, TR	Lights: AA, CA, CD, EC, MNPV42, MR, OH, RD, RI (blinking), SD, TM (blinking), TR
None	4,800 or faster (HS light), 300-2,400 bps (LS light)	1,200 bps (yellow blinking), 2,400 bps (yellow), 4,800 bps (red blinking), 7,200 bps (red-green blinking), 12,000 bps (green blinking), 14,400 bps (green)	1,200 bps (yellow blinking), 2,400 bps (yellow), 4,800 bps (red blinking), 7,200 bps (red-green blinking), 12,000 bps (green blinking), 14,400 bps (green)	All speeds (text)	14,400 bps (HS light)	4,800 bps or faster (HS light)	4,800 bps or faster (HS light), 9,600 bps or faster (V32 light)
V.21, V.23	V.21, V.23	None	None	None	V.21	V.21	V.21
None	None	None	None	None	None	None	None
□	■	■	□	■	■	■	■
Superset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes V Series	Superset of Hayes V Series	Superset of Hayes V Series	Superset, subset of Hayes 2400	Superset of Hayes 2400	Superset of Hayes V Series
Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Analog Devices	Hayes Optima	Hayes V Series
U.S. Robotics Group 3	AT&T Group 3, V.17	Motorola None	Motorola Group 3	Motorola None	Analog Devices Group 3	Rockwell Group 2, Group 3, V.17	Rockwell Group 3, V.17
Class 1	Class 1	None	Class 1	None	Class 1	Class 1, Class 2	Class 2
■	■	■	■	■	■	■	■
■	■	■	■	■	□	■	■
■	□	□	□	□	□	□	□
■	■	■	■	■	□	□	□
5 years	2 years	2 years	2 years	2 years	Lifetime	5 years	7 years

NETWORKING

V.32bis Modems

SUMMARY OF FEATURES

ENDS

■—Portable □—Desktop

PC MAGAZINE
EDITORS' CHOICE

Products listed in alphabetical order by company.

■ = YES □ = NO

	Zoom Telephonics Inc. Zoom/Modem VX V.32bis	ZyXEL ZyXEL U-1496plus	ZyXEL ZyXEL U-1496E
List price (tested configuration)	\$359.00	\$989.00	\$469.00
Communications software included	None	None	None
Facsimile software included	None	ZFax	ZFax

Physical Characteristics

Dimensions (HWD, in inches)	1.6 x 6.1 x 8.5	2 x 9 x 10.5	1.5 x 6.5 x 9.8
Case style	Standard desk phone	Wide desk phone	Standard desk phone
Power switch/Voice-operation switch	■ □	■ ■	■ ■
Volume control	■	■	□
Second phone jack	■	□	■
Distinctive ring for data/voice call	□	■	■
Status indicators	Lights: AA, CA, CD, EC, MNPV42, MR, OH, RD, RI (blinking), SD, TM (blinking), TR	Lights: AA, OH, PWR, RD, SD. Text: CA, MNPV42	Lights: AA, CD, CTS, EC, MR, OH, RD, RI (blinking), SD, SQ, TM
Speed indicators	4,800 bps or faster (HS light), 9,600 bps or faster (V32 light)	All speeds (text)	4,800 bps or faster (HS light)

Standards Supported

Additional data modulation methods supported	V.21	V.21, V.23, V.33	V.21, V.23
Additional command sets supported	None	None	None
Synchronous operation	■	■	■
Command sets	Superset of Hayes V Series	Subset of Hayes 2400	Subset of Hayes 2400
Error control and data compression command set	Hayes V Series	Hayes 2400	Hayes 2400
Data pump manufacturer	Rockwell	TI	ZyXEL
Fax capability	None	Group 3, V.17	Group 3, V.17
Fax command set	None	Class 2	Class 2

Technical Support

AT-command reference	■	■	■
Quick-reference card	■	■	■
Background information on communications included	□	■	■
Free support via toll-free number	□	□	□
Warranty	7 years	5 years	5 years

TI—Texas Instruments Inc.
AA—auto-answer enabled, CA—compression active, CD—data carrier detect, CTS—clear to send, EC—error control active, LB—low battery, MNPV42—MNP/V.42 mode, MR—data set ready, OH—off-hook, PWR—power, RD—receive data, RI—ring indicator, RTS—request to send, SD—send data, SQ—signal quality, TD—transmit data, TM—test mode, TR—data terminal ready.

almost always important. Unless you communicate with only a few other modems and can specify the modems on both sides of the link, insist on a modem with maximum interoperability. If you spend much time communicating with BBSs, pay particular attention to how well a modem works with the U.S. Robotics modem—a popular BBS choice.

Although 26 of the modems in this overview managed better than 75 percent reliability for making connections in our tests, three stand out as having a perfect connection record: the Motorola 3220 Plus, Practical Peripherals' PM14400FX PKT, and the ZyXEL U-1496plus.

A MATTER OF PROTOCOLS

Protocols are at least as important as performance in choosing a modem. Modems follow different kinds of protocols, including modulation, error control, and data compression protocols, each of which comes in different flavors.

Modulation protocols define the rules for encoding data—or modulating a carrier—as well stipulate such specifications as the frequencies to use and the speed or speeds for the modulation technique. They also define the rules for negotiating and maintaining a connection.

V.32bis, for example, is almost always identified as a 14,400-bps protocol, but 14,400 bps is the maximum speed. Depending on line quality, two V.32bis modems may establish a link at 14,400, 12,000, 9,600, 7,200, or 4,800 bps. If line conditions change, the protocol defines rules for shifting the speed up or down.

In general, two choices are available for shifting speeds (other than breaking the connection and trying again). A full retrain renegotiates the link in response to a drastic change in line conditions (as when the phone network has to reroute a call on the fly). A so-called fast transition simply falls forward to a faster speed or back to a slower one in response to more subtle changes in line quality.

When communications are running at less than 14,400 bps, for example, fall-forward allows either modem to request shifting the speed up—either on its own or through a manual command—and the other modem will respond. The ability to request a fall-forward or fallback *auto-*

See the Disk Spin.



CD-ROM
Drive

See the Disk Spin. See the Mouse Point. See How Computers Work.

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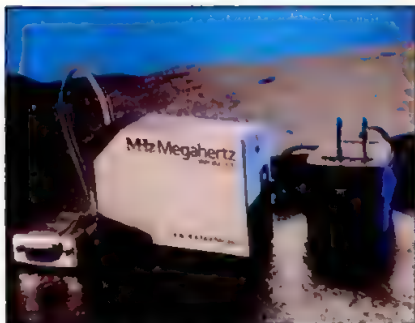
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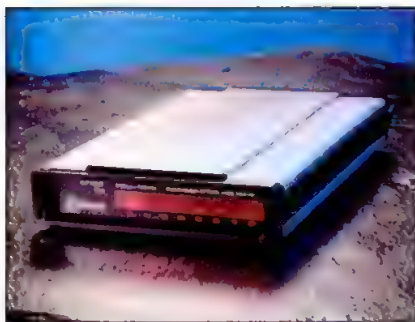
Modems will probably never become a major design element in most offices. But you may want to take a look at the size, shape, and other physical features of the available modems before buying. The pictures below illustrate the form factors and indicator light configurations described in the Summary of Features.



The 14400 Data/FAX Modem from Megahertz Corp. is a pocket modem. This particular unit bears a strong resemblance to an external LAN adapter. The 14400 Data/FAX Modem gets serious demerits for lacking status light indicators.



E-Tech Research's E-Tech UFOmate P1496MX is an oversized pocket modem—a curious form factor but one that may be appropriate for some briefcases. This modem also lacks critical status indicators.



Hayes Microcomputer Products' Optima 144-FAX144 is a classic standard desk modem, capable of holding a normal-size telephone. Many modem manufacturers have emulated the Hayes shape as well as its command sets.



The AT&T Comsphere 3830 can easily support the oversized desk phones found in many offices. The display on the AT&T Comsphere 3830 is thorough, providing more information in one view than many other modems.



Computer Peripherals' ViVa 14.4/FAX faux-marble miniature minitower is a strikingly attractive piece of office equipment. It also features an LED display composed solely of icons. You'll either love them or hate them.



We were impressed with the smart two-piece pocket design of the Practical Peripherals PM14400FX PKT modem. If you don't plan to use the battery pack, you can lighten your load by leaving it home.



The ZyXEL U-1496plus is another standard desk modem, capable of holding a normal-size telephone. Note the combination of LED lights and an LCD for troubleshooting. LCD readouts are becoming increasingly popular for modems.



The Practical Peripherals PM14400FXMT and the Zoltrix 144/144e are undersized desk modems—too small to set under a telephone. The Practical Peripherals modem comes with a stand for vertical setup.

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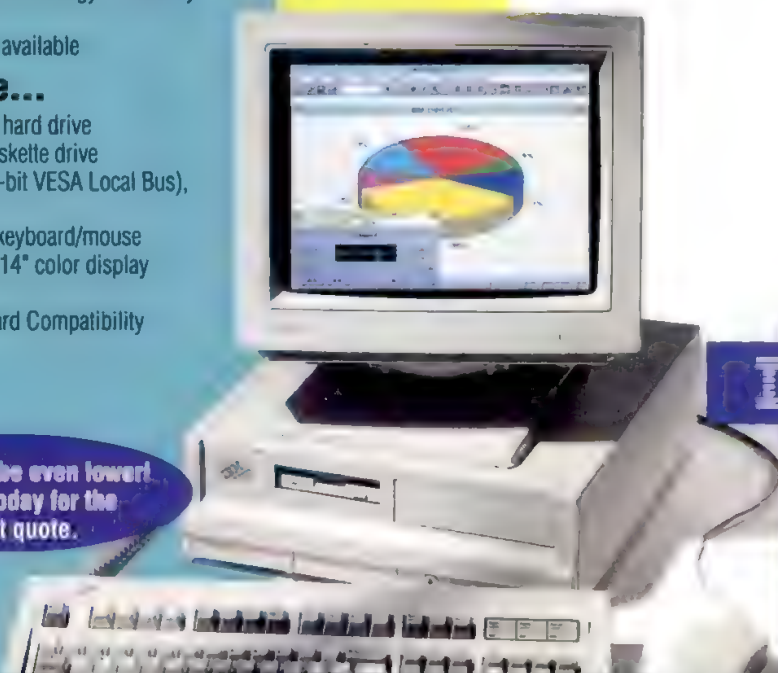
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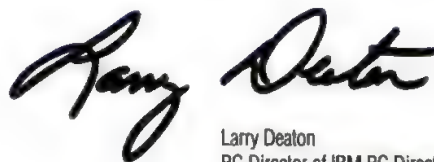
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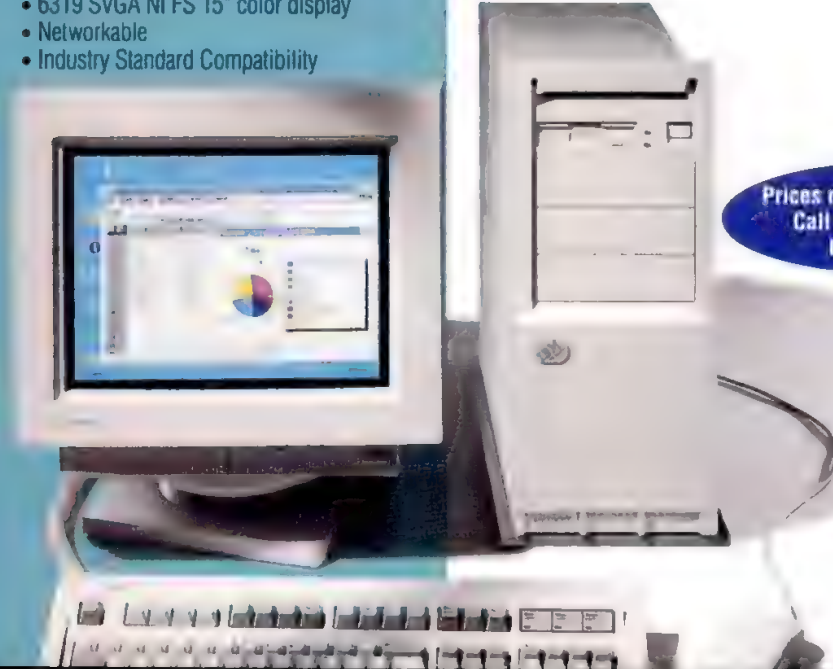
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matically is not required by the protocol, however. It's an option that some manufacturers have chosen to add.

In general, modems that include an automatic fall-forward and fallback request feature will monitor line quality and request a fall-forward when quality improves or a fallback when line quality deteriorates.

On today's phone networks, however, few data calls last long enough for line quality to change significantly during the course of a call. The likelihood of line quality changing will become even more limited as phone networks continue to improve. What's more, when changes in quality do occur, they are typically so disruptive to communications that they will force the modems to retrain anyway. So an automatic fall-forward or fallback feature will rarely come into play on the public phone networks, which is why you won't find the feature listed in our Summary of Features.

THE CORE SET

In addition to the V.32bis protocol, all the modems covered here support a number of other modulation schemes. In fact, you can expect to find a core set of protocols in just about any V.32bis modem.

The core set is essentially a list of protocols that have achieved the status of mainstream U.S. business standards at some time in the past. Bell 103, for example, is the U.S. standard for 0-300 bps; Bell 212 is the U.S. standard for 1,200 bps; V.22bis is the worldwide standard for 2,400 bps; and V.32 is the worldwide standard for 9,600 bps. The core set also includes V.22, the standard outside the United States for 1,200 bps.

You'll find all of these protocols in all of the modems covered here, except for Bell 103, which you'll find in all but two of the modems: Digicom Systems' Scout-Plus and XyComm Systems' Quick-Comm Spirit II.

These protocols ensure compatibility with the installed base of older modems. You may also find, however, that you need one of the older, slower protocols to establish reliable communications over poor lines. And if you want to ensure the greatest worldwide compatibility over the poorest connections, you'll want to make sure your modem offers V.21,

the 300-bps standard in most of the world outside the United States.

The core set includes all the modulation protocols that most users will ever need with the possible addition of V.21. One consideration for some users, however, will be the complicated issue of synchronous mode.

Communications can be either asynchronous or synchronous. In asynchronous mode, each byte is framed with start and stop bits, which the receiving side uses to identify the beginning and end of each byte. In contrast, synchronous mode

*On today's phone networks,
few data calls last long
enough for line quality to
change significantly during
the course of a call.*

sends data in blocks. The receiving side knows where each byte begins because the two sides are synchronized at the start of each block. Synchronous mode allows greater throughput for any given modem speed because it eliminates the need for start bits and stop bits.

Except for Bell 103 and V.21, which are both asynchronous only, most of the modulation schemes already mentioned can communicate modem to modem in either synchronous or asynchronous mode. (V.32 and V.32bis modems communicate modem to modem in synchronous mode only.)

Not all modems, however, offer a synchronous mode for connection to a synchronous terminal or appropriately equipped PC. The overwhelming majority of PC-based communications is asynchronous—with the modem plugging into the PC's asynchronous serial port and the PC running asynchronous software, such as DCA's Crosstalk or Datastorm's Procomm. Synchronous communications require special software and, with most modems, the addition of a synchronous port to the system for the modem to plug into.

Because most users never need a synchronous mode between the PC and mo-

dem, many modem vendors don't bother to offer one. If you need synchronous communications—for talking to a company mainframe, for example—be sure to pick a modem that offers a synchronous mode. You'll find synchronous modes in 47 of the modems covered here, but in only 4 of the 12 portables.

Besides those protocols already mentioned, you'll find others represented in the modems reviewed here. The most common is V.23, which is of interest primarily for anyone using Minitel, a European on-line system. Others include Bell 201A (two modems), Bell 201C (two modems), Bell 208A (four modems), and V.33 (four modems).

Bell 201A, 201C, and 208A are all strictly synchronous protocols—they require a synchronous terminal or a computer equipped with a synchronous port. As with synchronous communications with more common protocols, you're unlikely to need them.

Bell 201A, a 2,000-bps protocol, and Bell 201C, a 2,400-bps protocol, are nearly obsolete. The 4,800-bps Bell 208A protocol is more widespread but still confined to such special purposes as communicating with a company mainframe. V.33 is meant for leased-line operations.

The key point about special-purpose needs is that they are, in fact, *special-purpose*. If you have to ask whether you need a synchronous mode or one of the lesscommon protocols, you probably don't. If you have any doubts, check with the on-line systems you normally use—or expect to use. Find out what modulation protocols they support and whether they use synchronous or asynchronous mode. The essential requirement for picking modem protocols is to match those of the systems you want to call.

CONTROL AND COMPRESSION

In addition to modulation protocols, you should be aware of the error-control and data-compression protocols in any given modem. Because we limited this overview to modems with V.42bis data compression, you will find a number of error-control and data-compression schemes in every modem we've covered here. As with modulation protocols, however, you'll also find a few modems with a little something extra.

Pursuing the Holy Grail: Modem Interoperability

Super speed may sound like a great feature for a modem to have, but if a modem can't communicate, speed is of little help. We wanted to see just how effectively these modems could interoperate, so we tested them against those most commonly found among bulletin board services and commercial-access services.

We settled on three modems for testing. The Penril Alliance series was the overwhelming choice of both networks and commercial services. However, when it came to electronic bulletin board services, we found that the U.S. Robotics Courier series was dominant.

Finally, since we have seen a growing interest in the Internet, we looked to commercial providers of access to Internet services and found that many of them use Unix systems with Telebit modems, so we used the Telebit WorldBlazer with Telebit's proprietary protocol, Packet Ensemble Protocol (PEP) tones. By enabling PEP tones first, the Telebit WorldBlazer test let us know just how long each modem can stand strange tones before connecting. Those strange tones may be PEP emissions, calling tones from a European modem, or simply the result of calling an answering machine.

From each modem, we placed 60 calls to samples of each of the three host modems, attempted to transfer 32K of data during each call, then calculated the percentage of successful data transfers.

In our table, we use a green box to indicate those modems that connected and transferred the data successfully at least 75 percent of the time and a red box to indicate those modems that connected and transferred the data successfully no more than 25 percent of the time. A yellow box indicates those modems that fell in the middle of the range.

■ = High level of interoperability
 ■ = Moderate interoperability
 ■ = Minimal interoperability

	Penril Alliance V.32/14.4	Telebit WorldBlazer	U.S. Robotics Courier V.32bis Fax
Maximum DTE speed: 115,200 bps			
AT&T Comsphere 3820 SD	■	■	■
AT&T Comsphere 3830	■	■	■
CXR Telcom 1445-FXD1	■	■	■
Intel SatusFAXtion Modem 400/a	■	■	■
Penril Alliance V.32/14.4	■	■	■
Telebit WorldBlazer	■	■	■
Telecraft Pocket Genius3	■	■	■
Maximum DTE speed: 57,600 bps			
Adtech Companion 14/14p	■	■	■
Adtech Externally Yours 14/14e	■	■	■
Advanced Micro XPress 144S	■	■	■
American SmartFAX SF-1414-SAU	■	■	■
AMT Star 1442ef FAX/Data	■	■	■
AT&T DataPort 14.4/FAX SA	■	■	■
Best Data Smart One 1442FX	■	■	■
Boca 14 4Kbps External Boca Modem	■	■	■
Cardinal 14400V32bis	■	■	■
The Complete PC TurboModem PLUS External	■	■	■
Computer Peripherals ViVa 14.4/FAX	■	■	■
Dallas Fax 14.4 Pro Plus External	■	■	■
Digicom ScoutPlus	■	■	■
E-Tech UFOmate P1496MX	■	■	■
FastComm FDX 9842T	■	■	■
Forval SA 14400	■	■	■
GVC FM 144/144V	■	■	■
Hayes Optima 144 + FAX144	■	■	■
Identity 96/144 Send Receive Fax Modem	■	■	■
Logicode QuickTel 1414XV	■	■	■
Macronix MaxLute 144/PC	■	■	■
Mercury smallTALK	■	■	■
Microcom MicroPorte 4232bis with fax	■	■	■
Microcom OX/4232bis	■	■	■
Microcom OX/4232bis+	■	■	■
Motorola 3260	■	■	■
Multi-Tech MT1432BA MultiModem II	■	■	■
PerfectData Easy Modem 144	■	■	■
Practical Peripherals PM14400FXMT	■	■	■
Practical Peripherals PM14400FX PKT	■	■	■
Practical Peripherals PM14400FXSA	■	■	■
Racal-Datacom ALM 3223	■	■	■
Racal-Datacom ALM 3226	■	■	■
SupraFAX Modem V.32bis	■	■	■
Telebit T3000	■	■	■
Twincom 14.4 DF	■	■	■
Twincom Voyager	■	■	■
UDS FastTalk FAX 32bx	■	■	■
UDS FastTalk 32bx	■	■	■
UDS V.3229	■	■	■
U.S. Robotics Courier V.32bis Fax	■	■	■
U.S. Robotics Sportster 14400 Fax	■	■	■
U.S. Robotics WorldPort 14400 Fax	■	■	■
XyComm QuickComm Spirit II	■	■	■
Zotrix 144/144e	■	■	■
Zoom FaxModem VFX V.32bis	■	■	■
Zoom/Modem VX V.32bis	■	■	■
ZyXEL U-1496E	■	■	■
ZyXEL U-1496plus	■	■	■
Maximum DTE speed: 38,400 bps			
Megahertz 14400 Data/FAX Modem	■	■	■
Micro MiCC 14400PM	■	■	■
Micro MiCC 14400 SAF	■	■	■
Micro MiCC 14410 SAF	■	■	■
Micro MiCC 14420 SAF	■	■	■
Motorola 3220 Plus	■	■	■
NEC N9635E Plus	■	■	■
Omron Impeta 14 4K	■	■	■
Telenetics TC1442bis	■	■	■

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Understanding the interrelationship among error-control, data-compression, and modulation protocols is important. Error control and data compression are essentially independent of modulation schemes. More precisely, a given error-control or data-compression scheme will work only with modulation schemes that meet certain requirements (as we'll discuss shortly), but they will work with any modulation scheme that meets those requirements.

The preferred error-control scheme in V.42, for example, won't work with Bell 103, V.21, or V.23 protocols, but it will work with Bell 212, V.22, V.22bis, V.32, and V.32bis. And that means a V.32bis modem can connect with an older, slower modem and still take advantage of error control and data compression—as long as both modems offer the same error-control and data-compression protocols.

Error-control protocols aren't fully independent of each other. V.42, for example, defines a technique called LAPM (Link Access Procedure for Modems) as its preferred error-control mode, but also requires MNP 4 as a fallback mode. This ensures that your V.42 modem can establish an error-controlled link with an older modem that offers MNP 4 only.

In a somewhat different vein, MNP 4 requires either an MNP 2 or MNP 3 link. And while the preferred protocol in V.42 does not require an MNP link, the V.42 protocol specifies that a modem offer MNP 2 through 4 as a fallback mode.

Data compression builds on error control—modems must establish an error-controlled link before they can use data compression. Otherwise, if any part of the compressed data is lost, all the data that follows will be garbled. If a modem offers V.42bis data compression, for example, it must offer V.42 error control as well. And if it offers MNP 5 data compression, it must have MNP 2, 3, or 4 error control. (You will find that any modem with MNP 5 will also offer MNP 4.)

Because all of the modems in this overview offer V.42bis data compression, they will all offer V.42 (LAPM and MNP 2 through 4) error control. With that in mind, here's a look at the protocols you should be aware of, including a closer look at those we've already mentioned.

MNP protocols 1–3 divide into two

categories: asynchronous and synchronous. (All three protocols are typically used with asynchronous software in PCs and are, therefore, used with what is normally termed asynchronous-communications sessions. This division between synchronous and asynchronous refers strictly to the modem-to-modem communications mode.) MNP 1 and 2 send data asynchronously, using start and stop bits to indicate the beginning and end of each byte. MNP 1 is a half-duplex (one way at a time) protocol intended for error control during file transfer. MNP 2 and

*Understanding the
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modulation protocols is
important in evaluating
these modems.*

3 are full-duplex (two ways at a time) protocols intended for error control throughout a communications session.

MNP 3 uses synchronous mode between modems, though the DTE connection is asynchronous. As a synchronous protocol, it strips the start and stop bits added to each byte in asynchronous communications, and speeds throughput by adding less error-control information as framing bits than it eliminates. MNP 3 requires modulation protocols that offer a synchronous mode. And you can't implement MNP 3 in asynchronous software, since it will not work over the asynchronous link between PC and modem.

MNP 1 is essentially obsolete. Microcom, for example, doesn't include it in any of its current modems. MNP 2, 3, and 4 are still in common use, however. MNP 2 will let you connect with systems that provide MNP error control with software, and MNP 3 will let you connect with modems that offer built-in MNP error control.

MNP 4 is usually referred to as an error-control protocol, though it's actu-

ally an enhancement for either MNP 2 or 3. Working along with either an MNP 2 or 3 link, MNP 4 reduces overhead by providing a shorter header. It also monitors line quality and automatically adjusts the size of data packets to maximize throughput for any given line quality.

As already mentioned, the V.42 recommendation requires MNP 2, 3, and 4, which means you will find them in all of the modems reviewed here. And, of course, you'll also find LAPM, the preferred error-control mode in V.42.

MNP 5, V.42BIS, AND MORE

The two data-compression protocols that you'll find in every modem included here are V.42bis and MNP 5, both of which we've touched on already. In addition to being an official CCITT recommendation, V.42bis is more efficient than MNP 5. MNP 5 claims a 2-to-1 compression ratio and generally manages to boost throughput by between 60 and 80 percent. V.42bis claims a 4-to-1 compression ratio and generally increases throughput by about 100 to 120 percent.

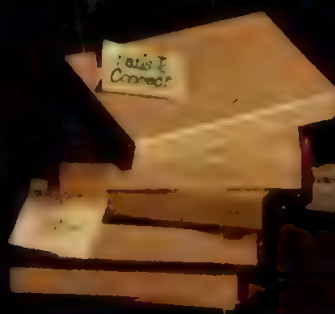
Unlike the relationship between V.42 and MNP 4, MNP 5 is not incorporated into the V.42bis recommendation. To take maximum advantage of data compression with older modems, however, you'll want MNP 5 as well. And indeed, all the modems covered here offer MNP 5 along with V.42bis.

In addition to this core set of error-control and data-compression protocols, you'll find a few additional protocols in the modems we cover. The only one worth noting here is MNP 10. Although usually lumped in with error-control protocols, MNP 10 is meant to improve reliability with varying line conditions, as you'll often find on cellular connections. Of the modems in this overview, two provide MNP 10.

FAXING ON THE CHEAP

Fifty of these modems offer fax as well as data communications. If you ever fax anything that starts out as data on your computer, a fax feature is well worth having. The typical premium for fax capability is \$40 to \$50. And a modem with fax capability gives you the significant convenience of being able to fax documents without having to print them first and

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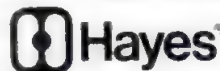


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CIRCLE 136 ON READER SERVICE CARD

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Company name	Product	Address
Adtech Micro Systems Inc.	Companion 14/14p	48430 Milmont Dr., Fremont, CA 94538
	Externally Yours 14/14e	
Advanced Micro Computer System Inc.	XPress 144S	1460 SW 3rd St., Pompano Beach, FL 33069
American Data Technology Inc.	SmartFAX SF-1414-SAU	44 W. Bellevue Dr., #6, Pasadena, CA 91105
AMT International Industries Inc.	AMT Star 1442ef FAX/Data	16571 Gemini Ln., Huntington Beach, CA 92647
AT&T Paradyne	AT&T Comsphere 3820 SD	8545 126th Ave. North, Largo, FL 34649
	AT&T Comsphere 3830	
	DataPort 14 4/FAX SA	
Best Data Products Inc.	Smart One 1442FX	9304 Deering Ave., Chatsworth, CA 91311
Boca Research Inc.	14.4Kbps External Boca Modem	6413 Congress Ave., Boca Raton, FL 33487
Cardinal Technologies Inc.	Cardinal 14400V32b s	1827 Freedom Rd., Lancaster, PA 17601
The Complete PC Inc.	TurboModem PLUS External	1983 Concourse Dr., San Jose, CA 95131
Computer Peripherals Inc.	ViVa 14 4/FAX	667 Rancho Conejo Blvd., Newbury Park, CA 91320
CXR Telcom Corp.	CXR Telcom 1445-FXD1	521 Charcot Ave., San Jose, CA 95131
Digicom Systems Inc.	ScoutPlus	188 Topaz St., Milpitas, CA 95035
E-Tech Research Inc.	E-Tech UFOmate P1496MX	3525 Ryder St., Santa Clara, CA 95051
FastComm Communications Corp.	FastComm FDX 9642T	45472 Holiday Dr., #3, Sterling, VA 20166
Forval America Inc.	Forval SA 14400	2099 Gateway Pl., #320, San Jose, CA 95110
GVC Technologies Inc.	GVC FM 144/144V	376 Lafayette Rd., Sparta, NJ 07871
Hayes Microcomputer Products Inc.	Optima 144 + FAX144	P.O. Box 105203, Atlanta, GA 30348-5203
Identity Systems Technology Inc.	Identity 96/144 Send Receive Fax Modem	1347 Exchange Dr., Richardson, TX 75081
Intel Corp.	SatisFAXtion Modem 400/e	5200 NE Elam Young Pkwy., C03-07, Hillsboro, OR 97124
Logicode Technologies Inc.	Quick Tel 1414XV	1380 Flynn Rd., Camarillo CA 93012
Macronix Inc.	MaxLite 144/PC	1348 Ridder Park Dr., San Jose, CA 95131
Megahertz Corp.	14400 Data/FAX Modem	4505 South Wasatch Blvd., Salt Lake City, UT 84124
Mercury Technologies	sma. 1A, K	685 Decarie Blvd., Montreal, Quebec, Canada H4L5G4
Micro Integrated Communications Corp.	MiCC 14400PM	3270 Scott Blvd., Santa Clara, CA 95054
	MiCC 14400 SAF	
	MiCC 14410 SAF	
	MiCC 14420 SAF	
Microcom Inc.	Microcom MicroPorte 4232bis with fax	500 River Ridge Dr., Norwood, MA 02062
	Microcom QX/4232bis	
	Microcom QX/4232bis+	
Motorola Codex	Motorola 3220 Plus	20 Cabot Blvd., Mansfield, MA 02048
	Motorola 3260	
Multi-Tech Systems Inc.	Multi-Tech MT1432BA MultiModem II	2205 Woodale Dr., Mounds View, MN 55112
NEC America Inc.	NEC N9635E Plus	1525 Walnut Hill Ln., Irving, TX 75038
Omron Office Automation Products Inc.	Impala 14.4K	3945 Freedom Circle, #400, Santa Clara, CA 95054
Penril DataComm Networks	Alliance V.32/14.4	1300 Quince Orchard Blvd., Gaithersburg, MD 20878
PerfectData Corp.	Easy Modem 144	1825 Surveyor Ave., Simi Valley CA 93063
Practical Peripherals Inc.	Practical Peripherals PM14400FXMT	375 Conejo Ridge, Thousand Oaks, CA 91361
	Practical Peripherals PM14400FX PKT	
	Practical Peripherals PM14400FXSA	
Racal-Datcom Inc.	Racal-Datcom ALM 3223	1601 N. Harrison Pkwy., Sunrise, FL 33323-2899
	Racal-Datcom ALM 3226	
Supra Corp.	SupraFAX Modem V 32bis	P.O. Box 7101, Albany, OR 97321-8000
Telebit Corp.	Telebit T3000	1315 Chesapeake Terr., Sunnyvale, CA 94089
	Telebit WorldBlazer	
Telecraft Industries Inc.	Pocket Genius3	3904 15th Ave., Brooklyn, NY 11218
Telenetics Corp.	Telenetics TC1442bis	26772 Vista Terrace Dr., Lake Forest, CA 92630
Twincom	Twincom 14 4 DF	6714 Netherlands Dr., Wilmington, NC 28405
	Twincom Voyager	
U.S. Robotics Inc.	Courier V.32bis Fax	8100 N. McCormick Blvd., Skokie, IL 60076-2999
	Sportster 14400 Fax	
	WorldPort 14400 Fax	
UDS Motorola	FastTalk 32bx	5000 Bradford Dr., Huntsville, AL 35805-1993
	FastTalk FAX 32bx	
	UDS V 3229	
XyComm Systems Inc.	QuickComm Spirit II	4270 Kellway Circle, Dallas, TX 75244
Zoltrix Inc.	Zoltrix 144/144e	47517 Seabridge Dr., Fremont, CA 94538
Zoom Telephonics Inc.	Zoom FaxModem VFX V.32bis	207 South St., Boston, MA 02111
	Zoom/Modem VX V.32bis	
ZyXEL	ZyXEL U-1496E	4920 E. La Palma Ave., Anaheim, CA 92807
	ZyXEL U-1496plus	

Toll-free number	Toll number	Fax number	Price of tested unit
800-783-3366	510-659-0756	510-659-9364	\$398 00
			\$298 00
800-972-3733	305-784-0900	305-784-0904	\$275 00
None	818-578-1339	818-578-1264	\$279 00
None	714-375-0306	714-375-0317	\$499 00
800-482-3333	813-530-2000	813-530-2398	\$995 00
			\$795 00
			\$359 00
800-632-2378	818-773-9600	818-773-9619	\$399 00
None	407-997-6227	407-997-0918	\$495 00
None	717-293-3049	717-293-3055	\$449 00
800-229-1753	408-434-0145	408-434-1048	\$399 00
800-854-7600	805-499-5751	805-499-5742	\$449 00
None	408-435-8520	408-435-1276	\$695 00
800-833-8900	408-262-1277	408-262-1390	\$289 00
800-328-5538	408-730-1388	408-730-2488	\$399 00
800-521-2496	703-318-7750	703-787-4625	\$799 00
None	408-452-8887	408-453-8886	\$995 00
800-289-4821	201-579-3630	201-579-2702	\$399 00
None	404-441-1617	404-449-0087	\$519 00
800-723-8258	214-235-3330	214-907-9227	\$249 00
800-538-3373	503-629-7354	503-629-7580	\$499 00
800-735-6442	805-388-9000	805-388-8991	\$399 00
800-468-4629	408-453-8088	408-453-8488	\$449 00
800-527-8677	801-272-6000	801-272-6077	\$499 00
800-561-4096	514-747-0254	514-747-0458	\$329 00
None	408-980-9565	408-980-9568	\$695 00
			\$695 00
			\$795 00
			\$995 00
800-822-8224	617-551-1000	617-551-1021	\$899 00
			\$899 00
			\$1,099 00
800-446-6336	508-261-4000	508-261-7105	\$795 00
			\$1,095 00
800-328-9717	612-785-3500	612-785-9874	\$799 00
800-222-4632	214-518-5000	214-518-5572	\$1,199 00
None	408-970-1121	408-970-1149	\$449 00
800-473-6745	301-921-8800	301-921-8376	\$646 00
None	805-581-4000	805-522-5788	\$895 00
800-442-4774	805-497-4774	805-374-7200	\$299 00
			\$499 00
			\$549 00
800-722-2555	305-846-1601	305-846-4942	\$1,145 00
			\$750 00
800-727-8417	503-967-2410	503-967-2401	\$439 95
800-835-3248	None	408-734-3333	\$949 00
			\$1,099 00
None	718-972-0900	718-972-4695	\$499 00
None	714-455-4000	714-455-4010	\$729 00
800-666-2496	919-395-6100	919-395-6108	\$499 00
			\$549 00
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			\$845 00
			\$995 00
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None	510-657-1188	510-657-1280	\$249 00
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			\$359 00
800-255-4101	714-693-0808	714-693-8811	\$469 00
			\$989 00

then scan them into a fax machine.

What most people mean by faxing is Group 3 fax, the standard that you'll find in the ubiquitous office fax machine. Group 2 and Group 1 are older and slower ancestors of the Group 3 standard. Neither was ever very widespread compared with Group 3. Until recently, conventional wisdom stated that Group 3 would inevitably be replaced by Group 4, a next-generation technology that provides high resolution and speeds of a few

***Fifty of these modems
offer fax as well as data
communications. The
typical premium for fax
capability is between
\$40 and \$50.***

seconds per page on a widespread basis. Group 3 standards have continued to evolve, however, until they now challenge Group 4.

Originally designed to transfer data at 9,600 bps on standard phone lines, Group 3 fax now offers 14,400 bps with the new V.17 protocol, and it includes a data-compression scheme that speeds transfer further still. (V.17 is just now beginning to show up on fax machines in the marketplace.)

Transmission time will vary, depending on the compressibility of a given page and the particular set of enhancements available on both sides of the link, but typical times now range from 30 to 60 seconds per page. Some vendors claim 9 seconds per page, but that assumes a highly compressible page.

With Group 3 performance now within shooting distance of what Group 4 promises, some analysts question whether Group 4 will ever be more than a dead end. One advantage of Group 4 is its independence of any particular modulation scheme. And some argue that it's positioned to become the new fax standard on the fully digital ISDN network that's beginning to replace the phone network we have today.

Communications Software: The Missing Link

If you've ever tried using a modem with an obscure communications package, you know the kinds of glitches that can arise. But by the time there's a problem, it's too late: You've already bought the modem.

We wanted to save you the pain of uncovering these problems alone.

Though there's no way to test a modem with every communications package on the market, we have taken three of the most troublesome packages that we know and put the modems through their paces. For each tested combination, we assign a score of pass or fail.

	Relay Gold 5.0	SmartCom III 1.0a	SmartCom Exec 2.1
Adtech Companion 14/14p	■	□	□
Adtech Externally Yours 14/14e	■	□	□
Advanced XPress 144S	■	□	■
American SmartFAX SF-1414-SAU	■	□	■
AMT Star 1442ef FAX/Data	□	□	□
AT&T Comsphere 3820 SD	□	□	□
AT&T Comsphere 3830	□	□	□
AT&T DataPort 14.4/FAX SA	□	□	□
Best Data Smart One 1442FX	■	□	■
Boca 14.4Kbps External Boca Modem	■	□	■
Cardinal 14400V32bis	■	□	■
The Complete PC TurboModem PLUS External	■	□	■
Computer Peripherals ViVa 14.4/FAX	■	□	■
CXR Telcom 1445-FXD1	□	□	■
Dallas FAX 14.4 Pro Plus External	■	□	■
Digicom ScoutPlus	■	□	□
E-Tech UFOmate P1496MX	■	□	■
FastComm FDX 9642T	■	□	□
Forval SA 14400	■	□	□
GVC FM 144/144V	■	□	■
Hayes Optima 144 + FAX144	■	□	■
Identity 96/144 Send Receive Fax Modem	■	□	■
Intel SatisFAXtion Modem 400/e	■	□	■
Logiccode QuickTel 1414XV	■	□	■
Macronix MaxLite 144/PC	■	□	■
Megahertz 14400 Data/FAX Modem	■	■	—
Mercury smallTALK	□	□	□
Microcom MiCC 14400PM	■	□	■
Microcom MiCC 14400 SAF	■	□	■
Microcom MiCC 14410 SAF	■	□	□
Microcom MiCC 14420 SAF	■	□	□
Microcom MicroPorte 4232bis with fax	■	□	■
Microcom QX/4232bis	■	□	■
Microcom QX/4232bis+	■	□	■

	Relay Gold 5.0	SmartCom III 1.0a	SmartCom Exec 2.1
Motorola 3220 Plus	■	■	—
Motorola 3260	■	□	□
Multi-Tech MT1432BA MultiModem II	■	□	■
NEC N9635E Plus	■	□	□
Omron Impala 14.4K	■	□	■
Penril Alliance V.32/14.4	■	□	■
PerfectData Easy Modem 144	■	■	—
Practical Peripherals PM14400F K PKT	■	□	■
Practical Peripherals PM14400F KMT	■	□	■
Practical Peripherals PM14400F KSA	■	□	■
Racal-Datacom ALM 3223	■	■	—
Racal-Datacom ALM 3226	■	□	■
SupraFAX Modem V.32bis	■	□	■
Telebit T3000	■	■	—
Telebit WorldBlazer	■	■	—
Telecraft Pocket Genius3	□	□	□
Telenetics TC1442bis	■	□	■
Twincom 14.4 DF	■	□	■
Twincom Voyager	■	□	■
U.S. Robotics Courier V.32bis Fax	■	□	■
U.S. Robotics Sportster 14400 Fax	■	■	—
U.S. Robotics Worldport 14400 Fax	□	□	□
UDS FastTalk FAX 32bx	■	□	■
UDS FastTalk 32bx	□	□	■
UDS V 3229	■	■	—
XyComm QuickComm Spirit II	□	□	□
Zoltrix 144/144e	■	□	■
Zoom FaxModem VFX V.32bis	■	□	■
Zoom/Modem VX V.32bis	■	□	■
ZyXEL U-1496E	□	□	□
ZyXEL U-1496plus	□	□	□

■ - Pass □ - Fail

A dash indicates that we did not test the product for compatibility with SmartCom Exec 2.1
Any modem compatible with SmartCom 1.0a should also work with Exec 2.1

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SI08" 3/5

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WinFax PRO 3.0 makes it easy to send, receive and manage faxes from within Windows. Since WinFax PRO installs just like a Windows printer, you can send faxes just as easily as you print documents—directly from Windows applications. Sophisticated document management tools let you categorize faxes using detailed descriptions, keywords, and archiving capabilities. Mark up faxes with powerful annotation tools. State-of-the-art OCR technology converts incoming faxes into editable files for your word processor or spreadsheet. This newest version, 3.0, now includes Cover Your Fax featuring 100 useful and attractive fax cover sheets. Or use the new Cover Page Designer and create your own. Maintain Multiple phone books and create groups for easy broadcast faxing. Supports most popular Class 2 FAX and Sendfax modems.

Publisher:
Delrina
Technology
FX0334

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Manufacturer: TS Robotics, MM2700

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The Complete PC	★ The Complete Communicator 3.0	299.95
FX0260		
The Software Toolworks	★ World Atlas 4.0 for Windows	49.95
ED4593		
Touchstone	★ Checkit PLUS	85.95
UT0734		
Traveling Software	★ LapLink V	109.95
UT3414		
U-Lead Systems	★ Imagepals 1.2 for Windows	89.95
GR4663		
Zaem Telephonics	★ FCV V.42 Fax Modem Internal	109.95
MM2330	★ VFP V.32 BIS Ext. 14400 S/R Fax	239.95
MM2140	★ VFP V.32 BIS Int. 14400 S/R Fax Int.	199.95
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Group 3 may win out even for ISDN, however, thanks to a new 64-Kbps digital-transmission scheme approved by CCITT in March 1993 to allow Group 3 transmissions over a digital network. Group 4 is a highly expensive, niche solution today; it's certainly not something you should be concerned about in choosing a modem.

You can expect any modem with fax capability to offer Group 3 compatibility. About a half-dozen of the modems reviewed here offer Group 2 compatibility as well. According to Janet Fugazzotto at BIS Strategic Decisions, a market research firm located in Norwell, Massachusetts, over 95 percent of fax machines worldwide are Group 3.

Five of the modems covered here support the new V.17 protocol. Although the lack of V.17 support is not a strike against a fax modem, count the inclusion of V.17 as a small plus. Under the appropriate conditions, it can boost speed, shaving a few seconds off the transmission time for each page—assuming the modem or fax machine on the other side of the link offers V.17 as well.

FAX SOFTWARE

In addition to the standards for talking over the phone lines, you should be aware of the standards that control fax modems. As recently as three years ago, all PC-based fax modems used proprietary approaches to fax modem control. That meant you were pretty well stuck with whatever software came with the hardware.

The marketplace is now increasingly moving toward widespread standards. As with the command sets for data communications, the goal is to ensure software compatibility. That's important, because even though many of the fax modems covered here come with fax software, the software is often a mere utility or, as with WinFax Lite, an entry-level program that you would do well to upgrade.

Although no single standard has the allegiance of every manufacturer, most external fax modems today are either Class 1 or Class 2 compatible. A few are compatible with both. And it's important to understand that Class 2 is not the same from one modem to the next.

Class 1 and Class 2 define the com-

mands that actually go to the modem. The key difference between them is that a Class 1 modem lets the computer handle all processing during a session; a Class 2 modem handles some processing itself. As you might expect, a Class 2 modem is inherently more expensive than a Class

*The Class 2 specification
has been—and to
some extent continues to
be—an evolving
standard for modems.*

1 modem, because it needs extra processing capability.

As the Class 2 mode was originally conceived, the key benefit of a Class 2 modem was that it would let background fax operations run more smoothly—with less interruption of foreground processing. In practice, however, Class 1 modems can handle background operations just as easily. In fact, with a well-written driver, Class 1 modems can handle background operations without problems, even on a 386SX/25 computer.

One complication is that Class 2 has been—and to some extent continues to be—an evolving standard. The Class 2 specification, officially TIA-592, was approved in November 1992. But none of the Class 2 modems we saw follow the 1992 specification, which was still too new at the time of our tests to have been used for any modems. Rather, these modems follow an interim version of the specification.

The approved version of the specification is usually referred to as Class 2.0 to distinguish modems that follow the approved specification from those that follow earlier, interim versions. In fact, the specification itself requires that a modem identify itself as 2.0 rather than 2 in response to the appropriate command. The response lets software distinguish modems that follow the finished specification from those that don't.

According to James Rafferty, president of Human Communications (a technology consulting firm based in Danbury,

Connecticut), most Class 2 modems on the market at this writing are based on the August 1990 interim version. Joel Borden of Thought Communications Inc., which markets FaxTalk and FaxTalk Plus fax software, points out, however, that different chip set manufacturers have slightly different implementations of even that interim specification, so that software has to perform slightly differently for each chip set.

You shouldn't count Class 2 compatibility (as opposed to Class 1 or Class 2.0 compatibility) as a serious strike against a modem, even though Class 2 is not uniform. Most fax software today already supports the various flavors of Class 2 and will continue to provide that support. Borden and Rafferty both expect to see Class 2 modems phased out relatively slowly. Even so, you might consider Class 2.0 or Class 1 support as a mild plus relative to Class 2.

Be aware of one other issue related to Class 2. The CCITT fax specification recently gained some new features—most notably support for such new data fields as a subaddress that will allow routing of faxes on LANs. The Class 2.0 specification has no provision for this and other newly adopted features, and discussion of updating the 2.0 specification to keep up with the fax protocols has already begun.

Class 1, in contrast, doesn't need an update to keep up with the new features in fax protocols. With Class 1 modems, the communications software handles all these features. For maximum flexibility toward future growth, then, you may want to give a little extra weight to Class 1 over either Class 2 or Class 2.0.

Issues of fax performance are extremely straightforward. On most phone calls, time is literally money, so faster is better. A few seconds difference per page isn't critical, however.

On our performance tests, most of the modems scored within a narrow range of acceptable performance, as indicated by a *pass* rating on the test tables. For modems that were slower than the acceptable range, we report the actual times. If you expect to use your modem for anything more than highly occasional faxing, pick one that passed both fax performance tests.

SOFTWARE COMPATIBILITY

Once you've narrowed the field of choices based on protocols, performance, and fax capabilities, you can concentrate on the modem's supporting features. Among these is software compatibility—how likely the modem is to work fully with your favorite communications software, or indeed, with any communications program you might pull off the shelf.

The key phrase here is *work fully*. Virtually any auto-dial modem will work with any standard communications package if you go to the program's terminal mode and type commands directly to the modem. The trick is for the modem and software to work together to automate various tasks—starting with dialing the phone.

How much you need to worry about software compatibility depends on how flexible you can be in your choice of software. If you don't connect to on-line systems that need special software and you're willing to switch to whatever software works with the modem, then compatibility with many types of software doesn't much matter. You can find any number of programs that will work with any auto-dial modem well enough to dial and establish a connection.

At the other extreme, software compatibility is critical if you're committed to a particular program or programs. You may, for example, already have extensive customized scripts that you don't want to re-create in another program. Or you may use a dedicated program for an on-line system—for handling your bank account, for example.

The last thing you want to discover after investing in a new modem is that it not only won't work with the software you have to use, but that the software vendor or on-line service isn't interested in helping you make it work.

If you decide that software compatibility is important to you, you're safest picking a modem that behaves as much as possible like any model of the Hayes Smartmodem. Hayes modems have been a standard for so long that virtually every communications program today supports most, if not all, models of Smartmodem. And in fact, many special-purpose programs (including CitiBank's Direct Ac-

cess software, for one) don't promise to work with anything else.

The widely used phrase *Hayes compatible* is best avoided. Hayes itself offers three significantly different command sets—the Smartmodem 300/1200 command set, the Smartmodem 2400 command set, and the Smartmodem V Series/Optima command set. And each of these includes several variations.

The differences among these command sets can be significant. A program designed for the Smartmodem 2400, for example, will not necessarily work with a Hayes V Series 9600 or 14400 modem. So in a very real sense, then, there is no such thing as a Hayes-compatible modem, merely modems that are similar to specific Hayes modems.

Our Summary of Features table shows

The last thing you want to discover after buying a new modem is that it won't work with your software and the software vendor or on-line service won't help you make it work.

which Hayes Smartmodem command set each tested modem is closest to. It also shows whether the tested modem's command set is an exact match to the particular Smartmodem command set, a subset, a superset, or an augmented subset. An exact match of command sets—which you'll find in seven of the modems covered here—obviously promises the greatest level of software compatibility. But subsets and supersets won't usually cause a problem either.

Because some software also adjusts error-control and data-compression settings, the features table breaks out the command set each modem uses for these advanced features. Give extra points to modems that support both the Hayes (V Series or Optima) and the Microcom commands for these features. Note, however, that each is widespread enough so

that you'll likely find support for both in any software that supports either.

You're least likely to find support for modems that use proprietary commands for these features—such as the modems from FastComm Communications, Multi-Tech Systems and Penril DataComm Networks.

We also tested the modems with software chosen precisely because it tends to be finicky about working with non-Hayes modems, in order to provide real-world indications of compatibility (for more information, see "Communications Software: The Missing Link"). The better a modem did on the software-compatibility test, the more likely it is to be compatible with any randomly chosen software that works with a Hayes Smartmodem.

LIGHTS ON, NOISES OFF

If you've ever had to troubleshoot a problem with a modem that lacked both a speaker and status lights, you know how frustrating the absence of such information can be. You may want even more information with V.32bis and V.42bis modems, so its absence can be even more frustrating.

As mentioned earlier, manufacturers' responses to the need for more information range from ignoring the issue, to adding extra status lights, to using combinations of changing colors and blinking patterns that are more confusing than helpful.

The Hayes Optima 14.4 + FAX144, for example, has the same eight status lights as the Smartmodem 2400. The Intel SatisFAXtion Modem/400e offers nine lights, many of which do double duty—or more—by changing colors, blinking, or both. And even after you decode the status information, you still won't know such details as whether you are in MNP or V.42 mode.

The good news is that several modems cut through the information overload quite elegantly, by offering it as text on an LCD. The ZyXEL U-1496plus, for example, shows the current speed of a connection, the modulation protocol, the highest level of error control and data compression, and more—and it shows it all as text. In addition, the ZyXEL U-1496plus front panel offers a few basic lights—including off-hook, auto-answer,

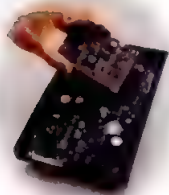


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Windows-Upgrade	F3	\$ 87
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Item #63329-08	F3	\$ 529
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Item #79785-02	Dual	\$ 45
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❑ Intuit Quickbooks		
Item #38392-02	Dual	\$ 89
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Item #23449-17	F5	\$ 134
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Item #26442-17	F3	\$ 134

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Item #26705-11		
❑ Symantec Norton		
Desktop for		
Windows 2.0	F5	\$ 115
Item #26718-11		
❑ Quarterdeck QEMM 386	F3	\$ 59
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❑ Quarterdeck QEMM 386	F5	\$ 59
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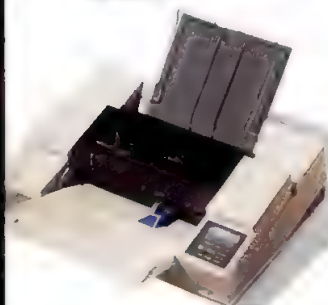
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and send data and receive data—so you can see at a glance whether the lights are on. Practical Peripherals offers much the same feature set in its PM14400FXSA. The Practical Peripherals modem has a smaller LCD, however, so it must cycle through the information rather than showing it all at once.

In general, you're better off with a modem that gives more status information than you need rather than one that gives less. And you're far better off with text than with lights only—especially lights that blink or change colors to give information. If you plan to use a single phone line for modem and voice calls, insist on an auto-answer light or the equivalent, so you can easily tell when the modem is set to pick up the phone.

If you're in the market for a portable modem, be prepared to make compromises on status information. Most of the portable modems covered here offer little in the way of status lights—typically four or less. The Practical Peripherals PM14400FX PKT is a notable exception, with eight lights.

All of the modems covered here include speakers. The ability to hear the dial tone, dialing, and a connection being made is essential for keeping informed and solving problems you may run into.

SIZE AND SHAPE

Although size and shape are easy to gloss over when choosing a modem, they can be important, particularly for a portable modem or if real estate on your desktop is at a premium. You will find the entries in the Summary of Features table color-coded to indicate one of several form factors. The key distinction among the desktop form factors is whether or not you can put a phone on top of the modem. If you need to conserve desktop space, pick a modem that will fit under your phone. If not, you can safely ignore the issue.

A mini-tower modem is taller than it is wide and too small to place a phone upon. An undersized modem can be any shape but is still too small to fit under a phone. A standard desktop-sized modem is just right for the classic, Western Electric, single-line phone—Hayes modems being the classic example of this size.

A wide desk modem is wide enough

for a Northern Telecom phone. An oversized desktop modem is noticeably larger than it need be to hold a standard phone, but it is too small for a wide office-style phone. Some of these phone-size listings are followed by an asterisk on our features table. This indicates that although the dimensions are right, you can't put a phone on top of the modem for some reason—typically because you'll block

***You're far better off buying
a modem with a text
display than purchasing a
unit that uses lights only—
especially lights that blink
or change colors, depending
on the information.***

cooling vents or status lights.

Portable modems include any modem that's designed to run on a battery. For maximum portability, smaller is better. For our purposes, a pocket-size modem is small enough to fit in a shirt pocket, while an oversized pocket modem is too large. The Practical Peripherals PM14400FX PKT earns its own category as a two-piece pocket modem by providing a separate case to hold the batteries. For portable modems, give an edge to the smaller form factor—but keep in mind that you'll also want to carry the transformer block with you.

AND ALL THE USUAL SUSPECTS

Don't forget to look at the more pedestrian aspects of each modem package—the contents of the package, manuals, warranty, and support. In the package, you may find fax software (if your modem supports fax) and phone cables. You may also find communications software and a serial cable.

If you don't already have a communications program, count a bundled program as a small plus. With most modems, as noted earlier, the bundled fax software is often limited. Give extra points to a full-fledged program such as WinFax 2.0,

which comes with Macronix's MaxLite 144/PC. By comparison, nine of the modems come with only WinFax Lite. Give extra points if the software matches the environment or environments you work in: DOS, Windows, or both.

You won't find an entry for cables on the features table, but all the modems covered here come with an RJ-11 cable for connecting to a phone line. And all of the portable modems come with a serial cable as well.

If you plan to plug a phone into the same line as your modem, you may also want a modem that includes a second modular phone plug, to save you the cost of a Y-connector. Eight of the portable modems and 45 of the desktop modems include the second connector. Several of the modems also offer a connector for a leased line, although we do not include that information in our table.

You'll also find some information on the features table about the documentation. If you're not already familiar with modem commands, you'll benefit from a thorough explanation of the modem's command set. And whether you're familiar with modem commands or not, look for a quick reference card. If you're new to communications, also look for a manual that offers some background information on communications in general.

Almost all of the modems come with unlimited free technical support. The only exception, as shown on the features table, is The Complete PC's Turbo-Modem PLUS External modem, which comes with only 60 days of free support. Give extra points to the 18 companies, representing 26 modems, that offer toll-free support.

Finally, consider the warranty. Twenty-three of the modems offer a two-year warranty. That's at least one year less than how long you'll probably wind up using the modem before upgrading. But if the modem lasts for two years, it will probably continue to last as long as you need it. On the other hand, 27 modems offer three years or more for the warranty; in fact, all but one of those five years or more. Count three years or more as a small plus for the modem, and one year or less as a minus. Telebit Corp.'s 90-day warranty is notably out of line with the rest of the batch. □

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Network Edition

THE LATEST NETWORK PRODUCTS AND MANAGEMENT TECHNIQUES

What Is the Perfect Pentium Server?

Are the new Pentium-based personal computers the greatest servers ever? Not yet, but eventually they will be. Find out what your next server should and shouldn't offer as *PC Magazine* explores Pentium server design.

By Jim Seymour

THE FIRST-GENERATION PENTIUM PCs deliver a marked performance gain over 486-based machines (see "Pentium: The New Standard," this issue). Though that gain is nothing to sneeze at—who wouldn't want a 75 to 80 percent increase in speed?—no network manager should be fooled into thinking these are full-blown, highly optimized Pentium PCs. One of the major challenges facing net-

work managers this year will be distinguishing between PCs rejiggered for the Pentium processor and the forthcoming Pentium-optimized PCs. You *will* want a Pentium server, but the shortcomings of the first bunch to hit the market offer important lessons in exactly where to look for Pentium's strengths.

The first Pentium computers are in many ways 486s rejiggered to accept the Pentium processor. The potential of Pentium-based servers and of the

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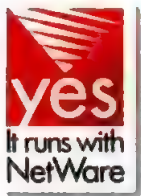
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expected network operating systems and networkable applications rewritten to exploit Intel's new chip is impressive, especially when you talk to hardware and software designers—the people on whose shoulders falls the task of making the Pentium revolution actually happen. But the engineering redesign necessary to exploit the Pentium fully is time-consuming and expensive, and we won't see fully re-engineered, second-generation Pentium-class machines until this fall.

Waiting for full-blown second-generation Pentium machines to become available may not be so important for the users of desktop PCs who buy these early versions mainly for standalone calculation-intensive work, such as computer-aided drafting or desktop publishing: They need every bit of extra speed they can get right now, especially if their applications rely on floating-point math rather than the more common integer math. The Pentium delivers about a fivefold improvement in floating-point performance over the fastest 486, but only about doubles the integer performance.

But networkers on the bleeding edge of technology ought to consider whether, especially in the ubiquitous Novell NetWare file-server/print-server environment, a server with a faster CPU, such as one of the first 60-/66-MHz Pentiums, will deliver the right kind of performance improvement. Faster network cards, more memory for bigger NetWare caches, and faster hard disks can all wring improvements from existing 486DX/50 and 486DX2/66 server designs that increases in raw CPU speed will not deliver.

MIGRATING TO PENTIUM

Just how much of Pentium's potential will the first group of machines be able to exploit? No more than 50 percent, estimated Glenn Henry, a former IBM Fellow and now senior vice president of the product group at Dell. He said many vendors are going to be offering Pentium upgrades for systems that are optimized for the 486 and that true Pentium servers are a ways off.

These upgrades will likely come in two forms. Processor cards will give you a quick upgrade that improves CPU performance quite a bit—especially if they contain a

large 64-bit cache. Accessing hard disks and networks, however, will be much slower than if you were using a machine optimized from the ground up for Pentium with a 64-bit architecture because you run into the 32-bit write-through cache required by the 486. Motherboard replacements will not be encumbered by this problem and will provide more of the functions that you need in order to take advantage of Pentium.

Even better than all these upgrades, though, will be the second-generation Pentium PCs. These products will fully exploit the 64-bit architecture, running fast 64-bit second-level caches and offering 64-bit memory access and fast, wide I/O buses. They are expected to hit the market this fall around the time of Fall Comdex, in November.

The importance of high performance in a server means that we'll see relatively few of the earliest Pentium machines from major vendors sold as servers. Most observers expected to see Pentium power applied first to performance-hungry networks in the form of applications servers, but almost every major PC maker says it is also working hard on true Pentium servers—that is, machines thoroughly re-engineered to exploit the Pentium—rather than merely trying to deliver quick-fix machines that stuff Pentium chips into systems designed for 486 processors.

When the second generation of Pentium PCs ships, commercial users will find them more impressive in serving applications—databases, for instance—than in serving files. Depending on the load handled by a NetWare server, for example, even 1,000 PCs may not be able to saturate an 80486 system. At one Novell demonstration, 1,000 clients ran a mix of DOS-based applications saturating a single Compaq SystemPro with CPU utilization still only at 42 percent. "The server was waiting for the network," said Novell's Bob Young, vice president of marketing for network products, "and that was only a 486 machine. What every-

one wants to see now is the throughput of the network increased, and then processor utilization can go up."

Even with processors saturated, it's the peripherals, disks and network card—and the I/O architecture that supports them—that are key to network throughput. Vendors anticipate that with emerging network standards such as Fiber Distributed Data Interface (FDDI) over

copper, 100-megabit per second Ethernet, and Asynchronous Transfer Mode, a new network server will evolve—one that no longer struggles along at 10 to 15 users but can scale up a few hundred or even several thousand users.

"If we were able to support 1,000 workstations on a 486

machine, we might be able to support 10,000 users on a Pentium-centric server," said Virgil Hornstein, director of North American Systems Products Division at Compaq. For Compaq, the key to those mega-network doors lies in the TriFlex architecture introduced in its new Systempro/XL—a 64-bit CPU bus, a 128-bit memory bus, and bus-arbitration logic.

SYSTEM DESIGN

What should you look for in the ideal Pentium machine? Most engineers working on Pentium machines have a short list of essential features: a 64-bit CPU bus, a 64-bit-wide Level 2 cache matched to the speed of the CPU (66 MHz now, 100 MHz later this year), and a 64-bit-wide memory subsystem with write-back and a high-speed I/O bus (possibly the Peripheral Component Interconnect [PCI] bus developed by Intel). According to Dell's Henry, PCI might be the best choice for an I/O bus because it's well-built, fast, and easy to implement. Specifically, PCI's good at reducing protocol overhead. PCI makes the data path wider without speeding up the bus too much, which would raise costs.

Hanging off of this bus should be the really intensive components of the system. The VGA-and-better video and

*With FDDI,
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network servers will
scale up to several
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Building the Perfect Pentium Server *By Nick Stam*

1 Cache Size

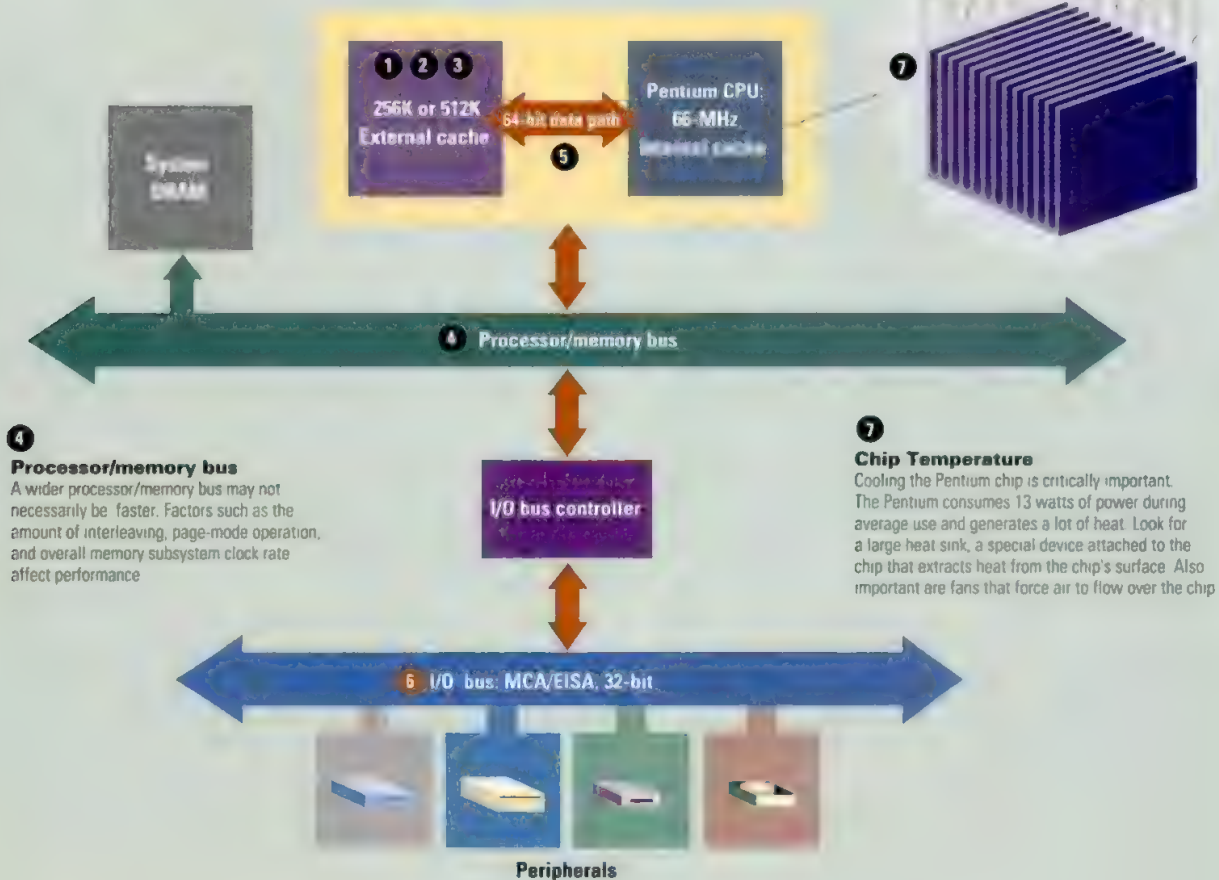
The external cache is a block of very fast memory that the processor can use as main memory. The larger the cache, the more data it can hold and the less time needed to perform such functions as translating network frames into system-level requests and executing device-driver code. In general, 256K is a minimum cache size for a Pentium server.

2 Cache Associativity

The number of cache locations a given memory location can map to is crucial. In the past, each memory location only had one corresponding external cache location (also called *direct-mapped cache*). High-performance caches, such as Intel's 82496, allow each memory location to be mapped to two corresponding external cache locations and are called *two-way set-associative*.

3 Cache Write-Policy

Determining when a cache should write to memory is an important issue. The best systems typically use write-back caches, in which the CPU writes to fast memory (the cache) and not directly to slower main memory.



4 Processor/memory bus

A wider processor/memory bus may not necessarily be faster. Factors such as the amount of interleaving, page-mode operation, and overall memory subsystem clock rate affect performance.

7 Chip Temperature

Cooling the Pentium chip is critically important. The Pentium consumes 13 watts of power during average use and generates a lot of heat. Look for a large heat sink, a special device attached to the chip that extracts heat from the chip's surface. Also important are fans that force air to flow over the chip.

5 Size and Speed of Bus Connecting CPU to External Cache

Though most Pentium servers will connect the cache and processor with a fast 64-bit data path, not all servers move data with the same efficiency (also called the *burst rate*). Some servers take three clock cycles to initiate the burst data transfer, while others may take only one or two cycles. This could mean a 33 percent difference in CPU-to-cache performance.

6 I/O Bus Design

Today, look for servers with an Extended Industry Standard Architecture (EISA) or Micro Channel architecture (MCA) bus. Tomorrow, servers will implement the new Video Electronics Standards Association local bus (VL-Bus) and Intel's forthcoming Peripheral Component Interface (PCI) local bus. PCI peripherals such as disk and network adapters should outperform their VL-Bus counterparts by up to 10 percent, thanks to improved buffering techniques and burst-mode transfer capabilities.

Seven key factors determine how efficiently a Pentium server processes network requests: cache size, cache associativity, cache write-policy, memory bus path, the size and speed of the bus connecting the processor with external cache, I/O bus design, and chip temperature.

P E N T I U M F I L E S E R V E R S

high-performance disk subsystems—fast Redundant Arrays of Inexpensive Disks (RAIDs), for example—need to go on PCI buses; but you don't need to put, say, network cards on PCI. Extended Industry Standard Architecture (EISA) is just fine for them.

Finally, you should look for a system with a really efficient heat-removal system. Machines with three or four fans and lots of space for airflow will pop up, predicted Henry. Other machines will provide innovative solutions for keeping the system cool. These solutions include various techniques, such as gel-packs and heat sinks coupled to their cases.

DATA INTEGRITY?

Aside from the bits-and-bytes decisions that have to be made in designing and setting up Pentium systems, organizational and philosophical decisions will need to be made in designing and installing these boxes.

Fault tolerance will become a critical issue. For perhaps the first time in the PC industry, manufacturers are going to *really* worry about building highly reliable systems. "Companies also will have to choose between downtime and system availability. Those are different and often competing issues," said Compaq's Hornstein.

The second-generation Pentium systems will also draw attention to the software that is running on them. Whether or not the software design and data structures are optimized for the Pentium will affect system performance. In databases, for example, these vendors are finding that they have to worry about whether data is stored in the traditional integer format or in floating-point format. "Storing all data in floating-point format really speeds things up," said Hornstein, "because that's where the Pentium's design makes the greatest contribution." Also, Object Linking and Embedding (OLE) and Dynamic Data Exchange (DDE) can also draw down a server's performance.

PENTIUMANIA

Another issue sure to stir up an extended technical debate—and undoubtedly, some economics arguments, too—is the potential inherent in multiprocessor Pentium servers. Adding CPU chips can substantially increase a PC's power—if the operating system running on the PC knows how to divide processing tasks among those chips. Novell's delays in supporting multiprocessor PCs has slowed the growth of the multiprocessor market, but the potential for combining 2, 4, or possibly up to 16 Pentium chips, as the NCR 3555 does, in a symmetrical multiprocessor (SMP) design has the imagination of hardware designers racing past today's uniprocessor norm.

Downsizing is key to this trend. As companies move down from mainframes and minicomputers, they find that their legacy applications, the ones they now have to move to PC local area networks and servers, demand enormous amounts of processor power.

The axiom that software expands to fill the capabilities of the underlying systems has never been more true. With SMP systems—where processing is equally shared among two or more processors—vendors can radically expand the computing capabilities of the underlying hardware.

Currently, many SMP boxes are two processor-based systems. But by year's end, argued Mike Kriger, director of advanced systems at AST Research, there will be more processors in the box. With four processor-based servers, we should see

secondary or tertiary caches of 256K or 512K, and maybe even 2MB to 4MB caches in servers with four or more processors. These second- and third-level caches speed up processing by letting the CPUs store up instructions and data that will be tapped repeatedly.

Network managers will have to decide whether to simply add Pentium uniprocessor servers to a network or to replace a single existing 486 server with a multi-

processor server built around either the 80486 or the Pentium chip. Novell's Young argued that using the distributed directory service introduced in NetWare 4.0 makes the number of servers on a NetWare network irrelevant, so that given the much-higher prices for multiprocessor servers, it's more economical just to add more uniprocessor machines.

But not everyone—including hardware vendors and customers—agrees. AST ships a multiprocessor server called the Manhattan. "A good number of the Mannhattans going out the door here at AST are going out as 'NetWare consolidation' boxes," Kriger said. "People are taking out four or five uniprocessor servers and replacing them with one Manhattan. Given the cost of NetWare licenses, it's just a lot cheaper and easier that way—especially by the time you add in installation, maintenance, and administration of those several separate servers."

Compaq's Hornstein wasn't sure he agreed—or that that's the right question. "In a NetWare environment, it may be cheaper to put multiple servers on a network." But in a Unix or NT environment, he said, "it's not clear that you'll do better economically with multiple servers versus one multiprocessor Pentium machine.

AN NT EDGE?

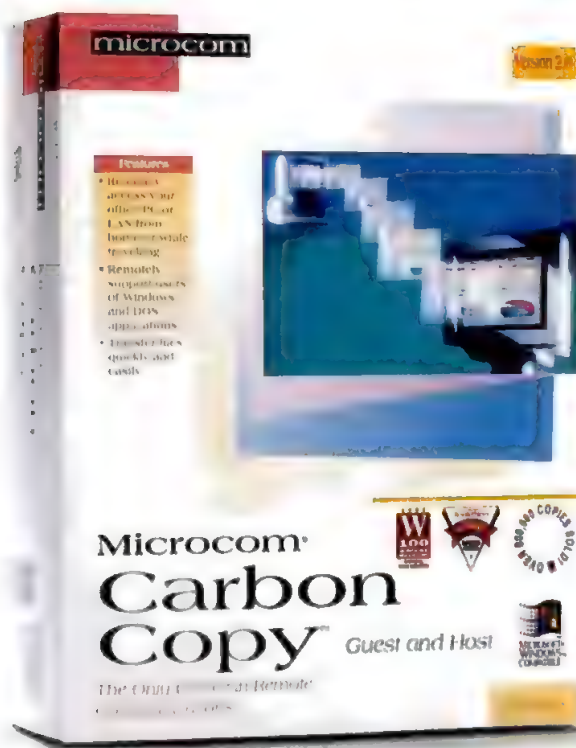
Software is a hugely important—if less-discussed—issue in looking towards Pentium PCs and the ways they will be designed and used in the years to come. Intel has made clear that recompiled applications software will be essential to getting the most out of Pentium-based systems.

Network operating systems have to be improved, too, to better exploit the chip. "From Novell's perspective," Bob Young said, "any time you get more processing power, we'll find ways to use it." He said customers can expect incremental improvements in much the same way that hardware vendors will be learning, step by step, how to make better use of the Pentium's powers. Expect an interim Pentium-optimized release of NetWare 4.0 later this year, followed by machine-specific support for multiprocessor Pentium machines in later NetWare 4.x releases.

While NetWare is likely to remain dominant among network operating sys-

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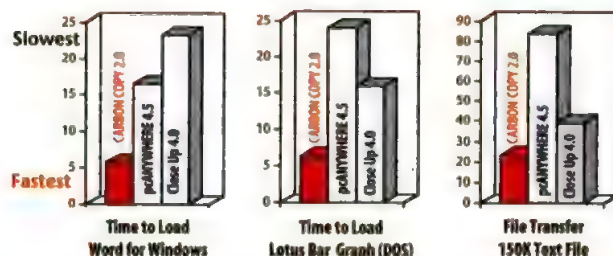
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tems for the foreseeable future, many hardware designers working on Pentium machines are more excited by the potential of server editions of Windows NT running on Pentium-based servers. "With Novell, you have to struggle and kick and scream to get into multiprocessing," one developer said, "But NT comes out of the chute knowing about symmetrical multiprocessing. And besides, if you think this is going to turn into a client-server world—and almost everyone in the business does—you have to wonder whether Microsoft isn't going to have a huge advantage in getting there first."

PURCHASE ORDERS ON HOLD

Potential customers for Pentium-based servers have their own agendas, of course, and, perhaps surprisingly, not many put Pentium servers high on their current lists of things to buy. Network administrators prize stability and security above all else, though price is still a major consideration for some. While they're eager to improve performance, those improvements have

to come within the context of safe, secure transitions from one stable environment to another. And these days, those improvements have to prove their cost-effectiveness almost immediately.

That's not the sentiment, though, in all corporations. Where the flow of information is the business, network managers are more interested in—if still not yet ready to leap to—the Pentium. An IS manager for a Wall Street firm has been eyeing Pentium servers as alternatives to the RISC chip-based systems he's been buying, but will switch only if he's assured that there's no performance trade-off.

NOT IF, BUT WHEN

Almost everyone in the network hardware and software businesses believes Pentium servers will change the rules for PC networks. Many potential Pentium server customers agree. If there is a gap between current market offerings and customer needs, it is in timing—just when does the revolution officially begin? And, probably, in cost: Most customers remain

skeptical that Pentium machines will be worth the substantial price, which will be significantly higher than the price of a 486 machine, this year. But 1994 looks like a different story.

As I/O and memory-subsystem improvements catch up with CPU technology—and as network interface cards for servers make big performance leaps, as seen in IBM's new Streaming Token-Ring card—the Pentium is going to become the CPU of choice for network servers.

As so often happens in the computer industry, the hardware has once again jumped ahead of the software. New Pentium-aware network operating systems supporting symmetrical multiprocessing are essential steps in delivering on the promise of Intel's new baby. Beginning with Windows NT, those NOSs are coming this year.

In tandem with this fall's Comdex, the new Pentium servers are going to change how we think about networks and about network performance. In networking, our world *has* changed. □

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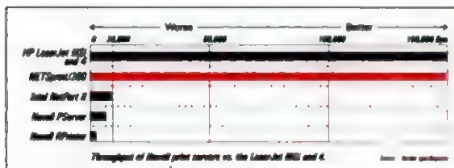
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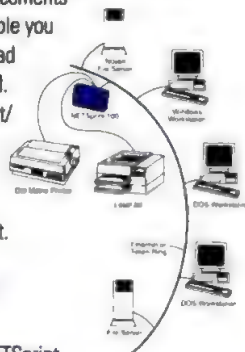
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NETSprint 200	Ethernet 10BaseT and BNC Thomson 4/10MB Token Ring DB9 and RJ45	Multiple Novell Apple	3 parallel 1 RJ45 Unprint	512K Flash ROM 256 RAM	\$995 (E) \$1495 (T)
JETPrint 100	Ethernet 10BaseT and BNC Thomson 4/10MB Token Ring DB9 and RJ45	Single Novell	1 AIO interface	512K ROM 512K RAM	\$895 (E) \$995 (T)
JETPrint 200	Ethernet 10BaseT and BNC Thomson 4/10MB Token Ring DB9 and RJ45	Multiple Novell Apple	1 MIO interface 1 RJ45 Unprint	512K Flash ROM 256 RAM	\$995 (E) \$1395 (T)

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NAT LANB/290 Remote IP Router/Bridge	70
Vitalink/MSC 4402 bridge-router	69
3Com NetBuilder II bridge-router	66
Newbridge Ethernet Lite Bridge	66
Proton CNX 500 Bridging Router	57
Xyplex 3210 local bridge-router	54
Wellfleet Link Node bridge-router	47
ACC ACS 4200 bridge-router	43
Microcom MBR 6000 bridge-router	35

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Networking: Speed to Burn

When users talk multimedia you talk 100Mbps+ networks. Here's the scoop.

by Frank J. Derfler, Jr.

IS FASTER ALWAYS BETTER? IN NETWORKING, absolutely. Higher speed on your network will become indispensable as new applications and new uses of LANs become more common. Video, imaging, and server fault tolerance all demand higher network speeds than are currently available. Even if you don't feel you need a faster network right now, you'd do well to understand the emerging options for fast local area networking. Chances are, you'll find yourself ordering a trial system within a year or so and doing an operational installation within three years.

Most of the new high-speed technologies propose a network speed of 100 megabits per second (Mbps), which is considerably faster than today's 10Mbps Ethernet standard and faster than the 4Mbps and 16Mbps of Token-Ring LANs. There are already a number of applications that could benefit from such speedy networks: the transmission of digitized X-ray images from a treatment facility to a consulting room, for example, or the mirroring of two servers using NetWare's SFT III operating system. Companies planning multimedia and network teleconferencing projects will also need LAN connections in the 100Mbps

range. One channel of broadcast-quality video requires about 8Mb of bandwidth, using the best available compression techniques, and audio demands just under 1Mbps.

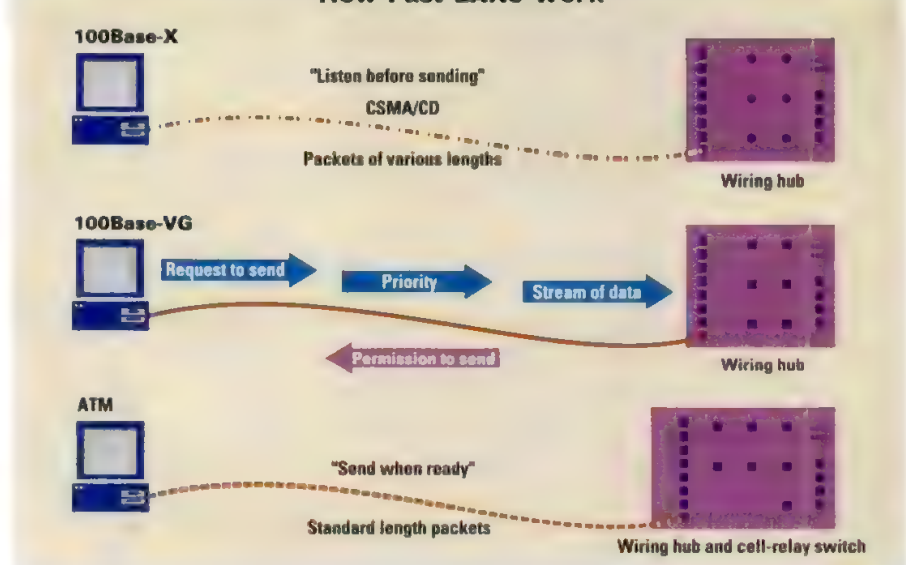
Fortunately for network managers, the uses of multimedia and video on the PC will have to become more common before

the demand for 100Mbps signaling is widespread; a number of competing approaches and proposals and a lot of incomplete technologies need to be resolved before fast LANs become commonplace.

If you have an immediate need for better throughput than 10Mbps Ethernet or 16Mbps Token-Ring provide, we advise taking a close look at *switching hubs*, an interesting technology available from several vendors, including Alantec, Kalpana, and Synernetics. With switching hubs, you can give a dozen or more nodes access to a full 10Mb of bandwidth without contention and keep your existing network interface cards, cable, and hubs. This technology uses finesse instead of raw speed and will appeal to many organizations.

The leading architectures in the race toward high-speed LANs include four contenders that can work on unshielded twisted-pair wire (UTP): 100Base-VG, backed by Hewlett-Packard and AT&T; 100Base-X "fast Ethernet"; Fiber Distributed Data Interface (FDDI) over copper; and asynchronous transfer mode (ATM). The underdog, though, is yet a fifth contender: FDDI over fiber-optic cable. Many people thought fiber had lost

How Fast LANs Work



ATM, 100Base-X, and 100Base-VG networking achieve the same goal—100-Mbps signaling—but they do it in very different ways. The 100Base-X fast Ethernet uses the familiar Ethernet CSMA/CD technique to share the channel. In the 100Base-VG architecture, the wiring hub controls the channel; after it receives permission to send, the node uses four pairs of voice-grade wire to broadcast its data.

“Wrong version of
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loaded on node 164.”

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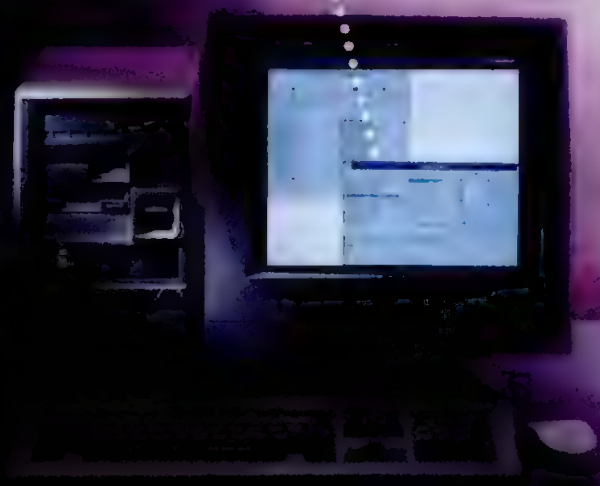
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the race because of its cost and complexity, but a number of recent developments have revived the fiber option.

THE ETHERNET PROPOSALS

The IEEE 802.3 committee, one of many standards-setting bodies, is the forum that develops Ethernet standards. It is here that the Ethernet giants are battling to define the 100Mbps standard. Two teams are pushing competing proposals for technology that will eclipse today's 10Mbps Ethernet signaling standard.

On one side, both Hewlett-Packard and AT&T are spearheading a group supporting a signaling and media access control scheme called 100Base-VG. More than a dozen companies, including Microsoft, Novell, and Ungermann-Bass, have announced plans to sell 100Base-VG products. On the other side, Grand Junction Networks is heading a group that proposes a different plan, called 100Base-X.

100BASE-VG: 100Mb ON VOICE-GRADE WIRING

The 100Base-VG proposal is so different from the current Ethernet protocol that many people argue that it doesn't belong in the 802.3 committee. The VG suffix stands for *voice-grade*, and the major appeal of 100Base-VG—and one reason for AT&T's support—is its ability to run over voice-grade UTP wiring (EIA/TIA Level 3 cable) instead of the less commonly installed Level 5 cable required by the other 100Mbps schemes.

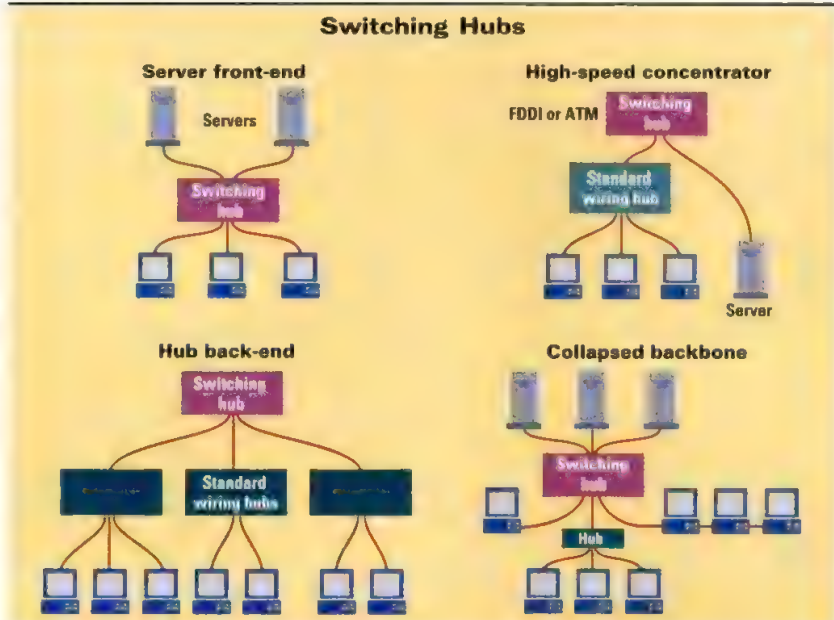
The *Ethernet* label HP has attached to its proposal is a misnomer or a marketing ploy. The 100base-VG architecture uses a completely different media access control scheme from the standard Ethernet Demand Priority Access Method (DPAM). Under the proposed architecture, priorities can be assigned to specific message packets. The node signals the

hub that it has a packet to send and requests either normal or high-priority service. If the network is idle, the hub allows nodes to transmit on a first-come, first-served basis. Since the node has permission to send, it doesn't need to listen, so it sends the packet to the hub in a broadcast, without contention, using four pairs of wires simultaneously. The hub is

commonly called fast Ethernet. Companies such as Intel, National Semiconductor, 3Com, Sun Microsystems, SynOptics Communications, and many others have a significant investment in Ethernet technology and have announced their intention to support fast Ethernet.

A 100Base-X installation will look exactly like today's 10BaseT. The connections are made over EIA/TIA 568 Level 5 cable, also known as UTP, currently the highest grade (as opposed to voice-grade) of UTP, with runs of up to 100 meters between a hub and a node. Fast Ethernet still relies on the same basic algorithm for regulating access to the network, carrier sense multiple access with collision detection (CSMA/CD).

The original Ethernet and the follow-on work by the IEEE 802.3 committee resulted in a standard that is not dependent on a particular speed. Each node listens to the



A switching hub can be used in four different configurations: as a server front-end, hub back-end, high-speed concentrator, or collapsed backbone.

expecting the packet and immediately forwards it to its destination. Higher-priority service requests are dealt with first, and multiple requests of equal priority receive first-come, first-served treatment.

While the attempt to use existing Level 3 wire is appealing, it's worth remembering that private branch exchange (PBX) installers traditionally run four wire pairs to each wall jack because one or two wires in this kind of installation are often unusable. People who want to install 100Base-VG will need to make careful checks of and improvements to their wiring system. If this plan is adopted, vendors will need new chips for their adapters and hubs, and the wiring hubs will become more expensive and complex devices.

100BASE-X: FAST ETHERNET

In the simplest terms, 100Base-X is the latest enhancement of Ethernet, so it is

cable and transmits when no signal is present. The inevitable collisions between stations are resolved by forcing each station to wait for a random period of time before transmitting again. This "yield to traffic" technique works at any speed. The 100Base-X adapters use faster signaling and space packets that are closer together than their 10Mbps ancestors, but the techniques are the same. On the practical level, this means that vendors will be able to market economical dual-speed Ethernet LAN adapters and hubs.

Many vendors have the Ethernet chip technology, so competition in fast Ethernet has a lot of appeal. But there is one potential drawback: You must have a good-quality wiring plant. While many organizations have used cable that meets the EIA/TIA 568 Level 5 standard, the quality of the cable doesn't guarantee the quality of the installation. Installers have

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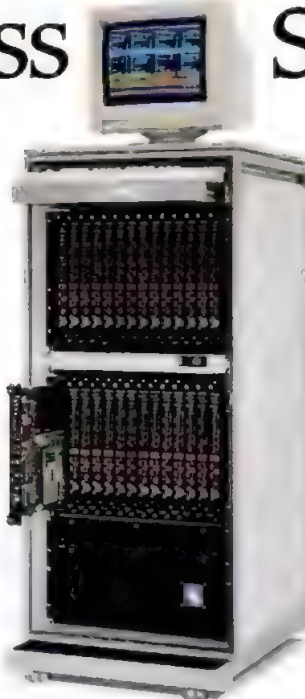
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to carefully dress the wires and use wall jacks, patch panels, and cross-connection blocks that sustain the low cross-talk requirements of Level 5. Many organizations will have to go through a cable certification process before they can install fast Ethernet adapters.

The alliances and proposals on all sides of 100Mbps Ethernet are still evolving. And there are other players, as well. Companies such as Plaintree Systems and LAN Media Corp. have competing technologies that may receive consideration. Another IEEE 802.3 committee meeting is scheduled this summer and should firm up the IEEE standards for fast Ethernet signaling.

FDDI

The major competitor to the fast signaling Ethernet schemes under consideration by the IEEE is FDDI. Despite its name, FDDI is not limited to systems that use fiber-optic cable. Under the latest definition of the American National Standards Institute (ANSI), the term FDDI can be used for schemes over fiber-optic, shielded twisted-pair, or UTP cable.

FDDI is a networking scheme that delivers high reliability through redundancy and sophisticated data-handling protocols. Fiber-optic cable under FDDI enables signaling to travel as far as 2 kilometers between a hub and node, but the higher cost of fiber has limited its popularity. The FDDI protocols can run over copper cable if you limit your distances to 100 meters and use a Level 5 UTP installation.

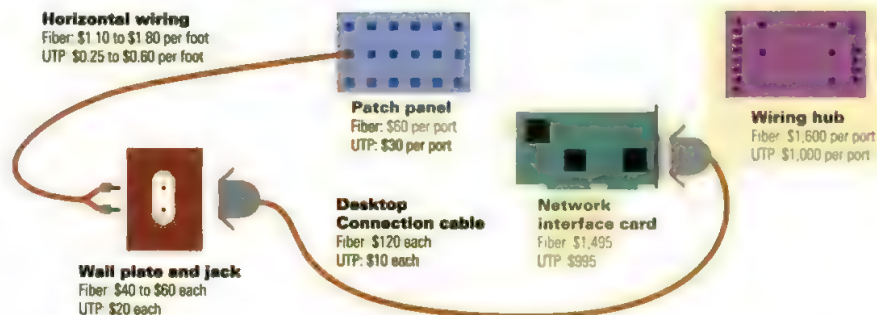
ANSI is working on standards for FDDI over copper. An ANSI committee has approved a plan for signaling using two pairs of Level 5 UTP, but an ANSI standard won't be finalized before the end of 1993. The draft ANSI standard uses a transmission scheme called Multi-Level Transmission-3 (MLT-3), which randomizes data to reduce emissions, and a method of equalizing signal levels. At the same time, IBM and other vendors are pushing for the use of FDDI protocols over shielded twisted-pair wire, a proposal that goes by the name *SDDI*. IBM, Network Peripherals, and SynOptics are among the companies presently shipping

SDDI modules for their chassis-based wiring hubs.

Crescendo Communications uses the term *Copper Distributed Data Interface* (CDDI) to describe products that use the FDDI techniques over UTP. Crescendo

about \$500 more than copper FDDI adapters. But two big companies, Motorola and HP, have recently thrown down the gauntlet on price. Motorola has announced significantly lower prices for its next generation of FDDI chip sets,

FDDI Costs Are Coming Down



This diagram shows the most expensive hardware elements of FDDI over unshielded twisted-pair (UTP) and over fiber-optic cable. The same elements are present in both types of installation, but the costs for fiber are significantly higher. Yet chip companies are pushing down the price of fiber network interface cards. A draft standard called Low-Cost Fiber reduces the price of the cable and connectors by 25 to 35 percent. The costs of the proposed 100Base-X fast Ethernet architecture will be similar to those of FDDI over UTP.

markets a 32-bit Micro Channel architecture (MCA) CDDI adapter designed for the IBM RS/6000 workstation for \$1,495 and an EISA CDDI adapter for \$995. An 8-port CDDI wiring hub retails for \$7,995. Other companies, including Network Peripherals, use the term *FDDI over UTP* to describe their products that conform to the ANSI draft standard. Network Peripherals has an Industry Standard Architecture (ISA) FDDI UTP adapter priced at \$995.

More vendors will be shipping FDDI-over-UTP products this summer. At this point, neither CDDI nor SDDI offer the ability to give priority to time-sensitive data such as full-motion video. Another ANSI committee is working on FDDI II, a new architecture that adds a priority capability for time-sensitive packets.

FDDI OVER FIBER

Why have so many companies gone to the trouble of putting the FDDI protocols over copper when fiber offers the capacity to transmit over longer distances, a higher resistance to outside electrical noise, better security from tapping, and additional bandwidth for growth? Cost is only one answer.

Currently, fiber FDDI adapters cost

which will affect all types of FDDI products. HP claims that its new chips will bring the cost of fiber-optic transceivers down by 75 percent over the next few years. If the cost of the transceivers comes down, will fiber to the desktop become popular? Probably not.

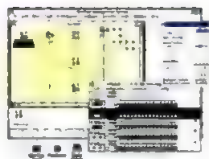
The other reservation about fiber is complexity. Despite its benefits, fiber isn't a comfortable technology for many managers. It takes a day of specialized training and about \$1,800 worth of tools to equip someone to install and repair optical fiber cables. Many managers believe that it takes only a few minutes of on-the-job training and \$200 worth of tools to equip someone to install UTP, although in truth, it takes as much or more training to be able to install and certify a Level 5 UTP cable plant. Still, the notion persists.

In addition, people in most organizations are typically more comfortable installing and repairing UTP than handling fiber. This is especially true because the component that receives the most stress and is most likely to fail—the end connector—is difficult to install in a fiber-optic system and relatively easy to install in any category of UTP and STP. Managers resist a technology that they

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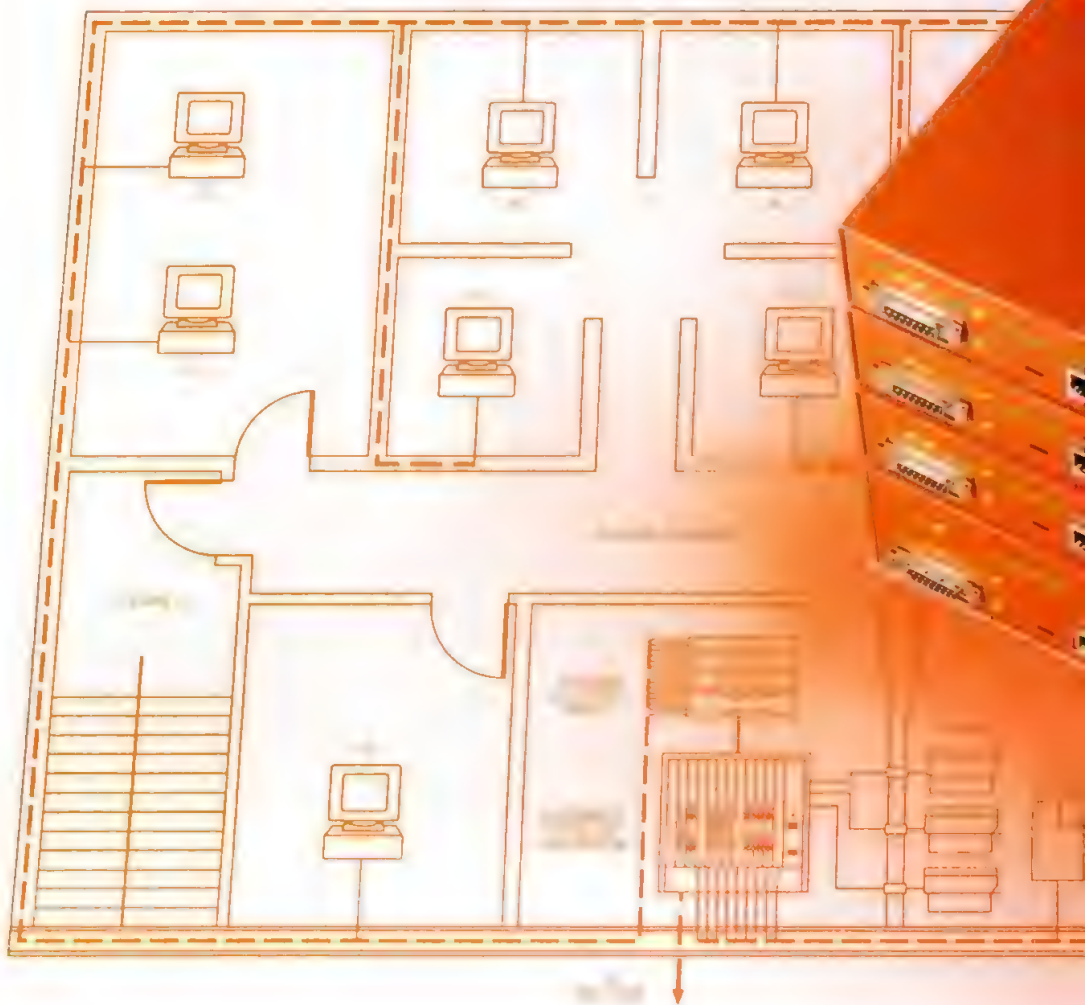
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can't handle with staff people because they feel they are at the mercy of outside services. Copper to the desktop is a well-known technology, but fiber to the desktop is not.

ANSI is working on a draft standard called Low Cost Fiber (LCF) that offers cost reductions and requires less skill to install. The LCF doesn't cost any less (the cable is the same), but the specifications for the transceivers and connectors have been loosened. In turn, the maximum distance has been reduced to 1 kilometer, but that isn't a significant limitation in most installations. The LCF proposal is expected to reduce the cost of a fiber-optic installation by 25 to 35 percent.

ATM

ATM is a technology that has received a lot of attention but isn't quite ready for desktop prime time. ATM is a cell-switching scheme that divides the stream of data into 48-byte cells. An additional 5-byte header provides routing information for a series of network cell switches. Because the cells are small, time-sensitive data such as voice and video can mix with other data without suffering much of a delay. If a few cells get out of sequence, a little buffering takes care of the tiny interruption. This architecture reduces the overhead in the switches and makes it possible to use the same ATM data cells between desktops or between cities.

ATM's appeal comes primarily from its broad support. Large and small companies are lining up to offer ATM products in every niche. Standards are in place at many levels, and ATM will grow from the WAN into the LAN over the next couple of years.

The first commercial use of ATM is Switched Multimegabit Data Services (SMDS), which is being installed by telephone companies around the country. This service provides economical 45Mbps connections across a metropolitan area. Bellcore, the laboratory of the Bell Operating Companies, defined SMDS according to IEEE 802.6 WAN standards. SMDS can be scaled up to 622Mbps as demand grows.

SMDS will appeal to many network managers as an ideal way to link LANs. But as ATM technology gets closer to the

desktop, higher speeds become more economical. The next step toward the desktop for ATM will come in the form of a backbone connection between wiring hubs. A number of companies, including Ungermann-Bass, SynOptics, and Cabletron, have announced wiring hubs that have ATM capability. ATM adapters for MCA/EISA PCs will operate at 155 Mbps over copper twisted-pair and fiber-optic cable, but the final UTP cable specifications are hazy.

Digital Equipment Corp. has invested years of work in cell switching under a project called GIGAswitch. By mid-1994, Digital intends to deliver ATM products that include a family of ATM switches and modular hubs as well as LAN and WAN ATM connections using speeds from 45 to 622Mbps.

HUB SWITCHING AS AN OPTION

All the technologies we've described so far require a major upheaval of your networking infrastructure to deliver more bandwidth. You'll have to throw out existing LAN adapters, run new cables, and hunt for new drivers. However, a number of vendors, including Alantec, Kalpana, and Synernetics, offer products called switching hubs that are a much less disruptive and more economical alternative.

Switching hubs don't provide faster signaling, but they enable greater bandwidth and provide faster throughput. You keep your present Ethernet LAN adapters, and they still work at 10 Mbps, but each adapter thinks it is the only one on the network. Unlike all of the other alternatives, switching hubs don't subdivide the network bandwidth among all of the active nodes. A fast processor in the hub moves the packets across a backplane operating at hundreds of megabits per second. This is called a *collapsed backbone architecture* because the switching hubs act like a series of individual wiring hubs connected by a fast backbone link.

In practice, most computers can't take

advantage of the full 10Mbps Ethernet channel, so these companies offer products that allow you to share 10Mb of bandwidth between anywhere from one to eight nodes. Prices range widely among

various products. Alantec generally offers TCP/IP routing and Simple Network Management Protocol (SNMP) management for about \$1,500 per 10Mb port. Kalpana is the price leader, with each SNMP-managed 10Mb port costing about \$800 without

*Switching hubs
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bandwidth and faster
throughput over
existing Ethernet LAN.*

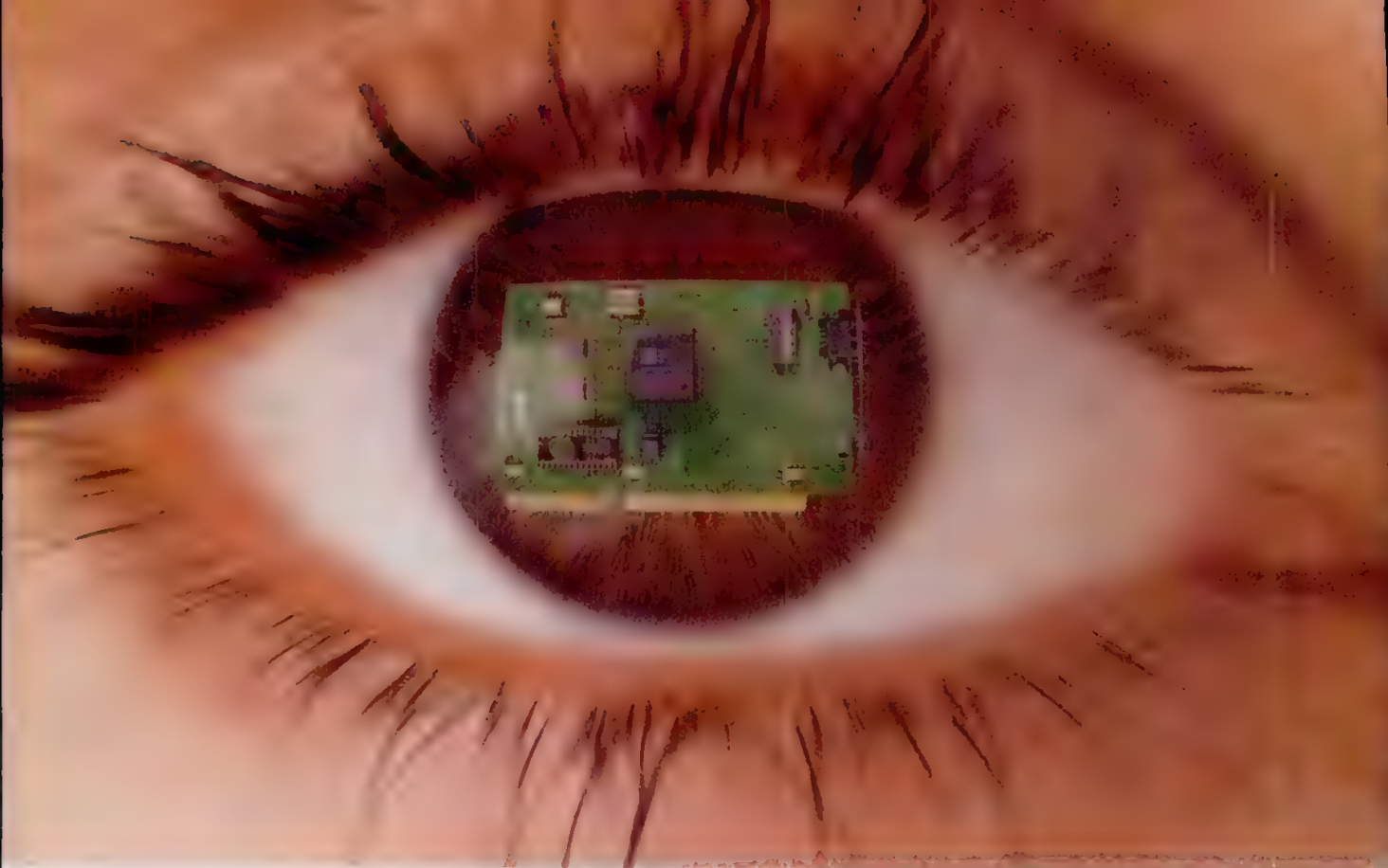
routing. As you add more nodes to the 10Mb bandwidth, you generally divide the cost by the number of ports. For example, giving three ports access to a dedicated 10Mbps Ethernet costs about \$500 per port in the Alantec system.

Generally, you can install switching hubs in one of three different configurations: server front end, back end to a group of hubs, high-speed wiring concentrator, and FDDI concentrator. As a server front end, a switching hub is the only connection point for one or more servers. Each server gets the maximum bandwidth it can use while the client computers compete for more limited bandwidth.

As a back end to a group of nonswitching wiring hubs, a switching hub acts as a very fast yet economical backbone. As many as a dozen hubs can have 10Mb bandwidth with no competition for the channel. As a high-speed wiring concentrator, a switching hub allows the administrator to give each node the necessary amount of bandwidth.

TACTICAL MOVES

People who need faster networking today have a number of options. Switching hubs have strong appeal because you can keep what you have while you improve throughput. The UTP FDDI adapters are still evolving, so consider carefully before committing to this technology. Be sure new cabling adheres to Level 5 standards and get a profile of every cable run. This type of installation will give you the throughput and flexibility needed to move your data quickly and reliably. □



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FIRST LOOKS

HANDS-ON EVALUATIONS OF THE NEWEST NETWORK PRODUCTS

► APPLICATION SERVERS

Tricord's ES5000: Peak Performance, High Reliability

BY STEVE BUEHLER

Tricord's new state-of-the-art super-server, the ES5000, brings mainframe features and impressive performance to the enterprise server market. This fully symmetrical multiprocessing machine provides the power to drive the toughest of applications, whether they are running The Santa Cruz Operation's Unix, Novell's NetWare, or Banyan's VINES. Its base list price is around \$75,000.

Though IS managers contemplating moving applications from a mainframe or minicomputer system to the Intel platform will find the performance of the ES5000 exciting, perhaps more significant is Tricord's emphasis on reliability, scalability, and system management.

Reliability begins with the server's seven-slot chassis. All active components that might fail are kept on plug-in modules and not on the backplane. This is the opposite of many PC manufacturers, who reduce costs by consolidating components on a single motherboard.

Two modules that slide into these slots: CPU boards and Intelligent Storage Subsystems (ISS). The CPU boards currently ship with i486DX/66s, though Tricord will eventually offer the Pentium processor. A total of six CPU modules can be installed in the ES5000. Each ISS ships with four NCR SCSI controllers to support up to 28 SCSI devices.

Memory is on a separate module, which slides into its own slots. Error Checking and Correcting (ECC) memory is used to

detect and correct memory errors. Tricord extends error detection through the system by using parity on the bus. Should memory blocks fail, network managers can remove them from use with ES5000's Intelligent Management Subsystem (IMS).

IMS is a Windows application that mon-

itors system usage, resources, and logged events. It gathers the information in the server from a battery-backed processor, which functions even in the event of a system failure.

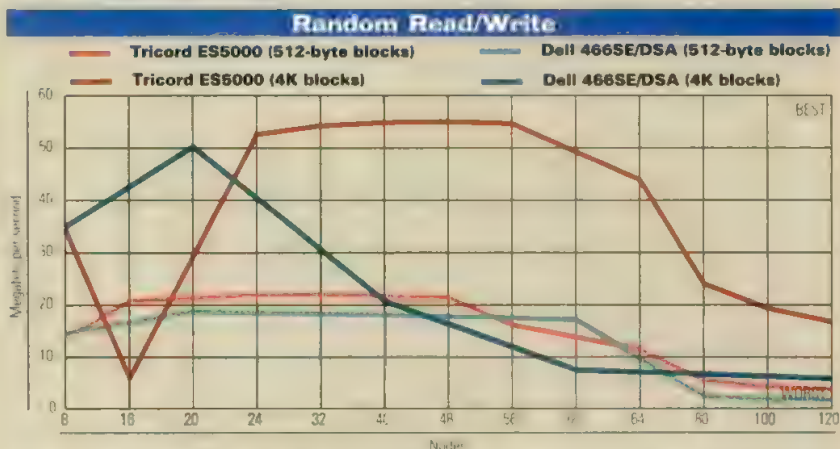
For enhanced reliability, Tricord built in Redundant Array of Inexpensive Disks (RAID) levels 0 (disk striping) and 1 (disk mirroring). According to Tricord, RAID 5 (distributed parity) will also be available.

Four 500-watt power supplies, which provide 1,500 watts of operating power and 500 watts of standby, drive the ES5000. One of the unique features of the ES5000 is its ability to assign standby power supplies and SCSI disks. Should a disk in a RAID configuration or a power-



Benchmark Tests: Tricord ES5000

Megaserver is probably the best way to describe the Tricord ES5000. On our I/O throughput tests, the ES5000 was far faster than previously tested NetWare servers. And that's without taking advantage of its multiprocessing capabilities.

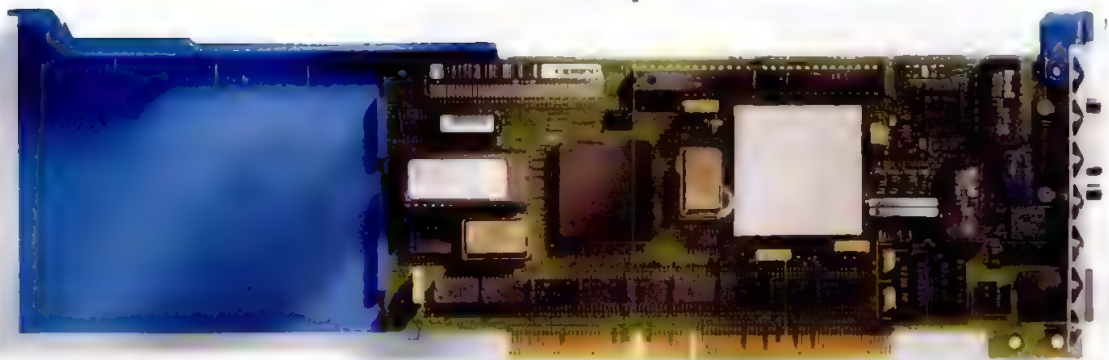


The ES5000 showed a gradual drop-off in performance when more users were added. A server's performance usually drops dramatically when cache limits are exceeded and disk I/O rises, then levels off at the machine's disk-limited throughput. On our tests, the Dell and the Tricord both hit a maximum throughput of over 50 megabits per second with 4K blocks being requested from disk, but the Tricord's performance curve was higher overall. As more users were added, the ES5000 took the additional burden quite well, and its higher-performance disk subsystem maintained significantly higher throughput levels.

We tested the throughput capacity of the ES5000 using the Random Read/Write test from ZD Labs' NetBench 2.06—a measure of the platform's ability to perform as a file server. NetBench was configured to generate a series of requests using 512-byte blocks. The test results for the Dell 466SE/DSA PowerLine Server are reported for comparison and are taken from a previous review ("To Protect and Serve," *PC Magazine*, May 11, 1993).

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supply fail, the ES5000 can immediately move the standby device into operation.

Connecting these subsystems and modules together is an internal 64-bit PowerBus capable of up to 267 megabytes per second (MBps), according to Tricord; plenty of power for supporting Pentium processors and dozens of SCSI devices. This high-speed bus and controller, for example, allow the internal EISA bus to access data in memory at 33 MBps.

And its performance showed. The ES5000 was simply the fastest machine ever tested under the ZD Labs NetBench, Version 2.06, network performance tests. But part of that may be deceiving. The ES5000 was also far more sophisticated than any of the products we've tested before, including a Dell 466SE/DSA—one of the top performers in our last single processor test. The Tricord and the Dell both hit a maximum throughput of over 50 megabits per second (Mbps) with 4K blocks being requested from disk. However, as more users were added, the ES5000 continued to perform quite well. At 120 clients, the ES5000 doubled the Dell's throughput.

The ES5000 clearly benefited from Tricord's intelligent disk-management subsystem and a write-back cache, which delays disk writes where possible until idle CPU cycles. This storage access architecture can overwhelm a single i486/66 in certain scenarios, such as query-intensive database applications. In such environments, multiple 486 CPUs or Pentiums would be an obvious upgrade option.

The ES5000 has a three year warranty and runs most network operating systems including SCO Unix, Univel UNIXWare, VINES, and NetWare 3.11 and 4.0.

The ES500's EISA architecture supports all major networking topologies

Performance, uninterrupted availability of processing, along with excellent system management tools for optimization, tuning, and elimination of bottlenecks puts the Tricord ES5000 at the front of the pack for today's enterprise computing solutions.

• List price: *ES5000 (one i486DX2/66, 64MB RAM, 500M hard disk space), \$75,950; Tricord Systems Inc., 3750 Annapolis Lane, Plymouth, MN 55447-5438; 800-729-5055; fax, 612-557-8403. Circle 972 on reader service card*

► COMMUNICATIONS

US Robotics Offers Shared Access

BY STEVE RIGNEY

When mobile executives need access to the corporate network, LAN managers must find a solution that offers the functionality and ease of use they demand. U.S. Robotics has two such solutions for NetWare—the Shared Access Communication Server 386 and the Shared Access LAN Modem. Both offer remote node and remote control of any PC equipped with U.S. Robotics On-the-LAN Host Program. Though harder to install than their competitors, they offer superb functionality and are a good buy.

With remote control, users access the network by controlling a networked PC. Applications run on the networked PC; only screen changes and keystrokes are passed across the remote connection. With remote node, applications run on the remote PC; the PC becomes a regular node on the office network.

U.S. Robotics is one of the first vendors to include remote control and remote node with a diskless workstation: the Shared Access Communication Server 386 (CS386). The CS386 is easy to install and supports both dial-in and dial-out phone calls. The CS386 is about the size of a notebook PC and comes equipped with a 386SX processor, 2MB RAM, a 14,400-bps

modem, and a network adapter card and driver for NetWare. The CS386 can connect to any NetWare 2.14 or higher Ethernet network.

The Shared Access LAN Modem is aimed primarily at remote-node users. It offers a 14,400-bps modem with a built-in Ethernet adapter and an extra serial port for an external modem.

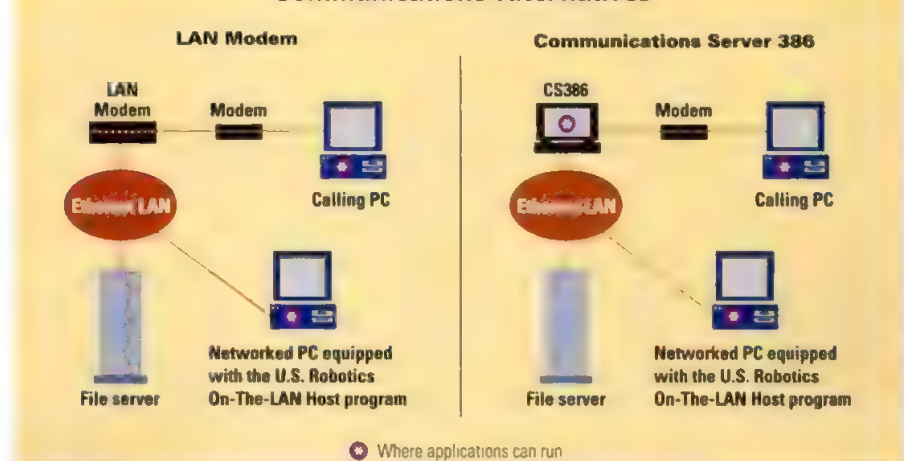
Both devices provided remote-access performance on a par with the Shiva NetModem/E and Artisoft's Central Station. Installing these products was a bit more difficult than installing competing products from Shiva and Artisoft, which provide electrically erasable programmable ROM (EEPROM) that contains important boot information. With the LAN Modem, you must create remote-boot images for each specific remote-access device on the NetWare server.

With dial-in and dial-out, the CS386 also offers functionality not found in many competing products.

• List price: *Shared Access Communication Server 386, \$1,995; Shared Access LAN Modem, \$1,695. U.S. Robotics Inc., 8100 North McCormick Blvd., Skokie, IL 60076; 800-982-5151, 708-982-5010; fax, 708-982-5235.*

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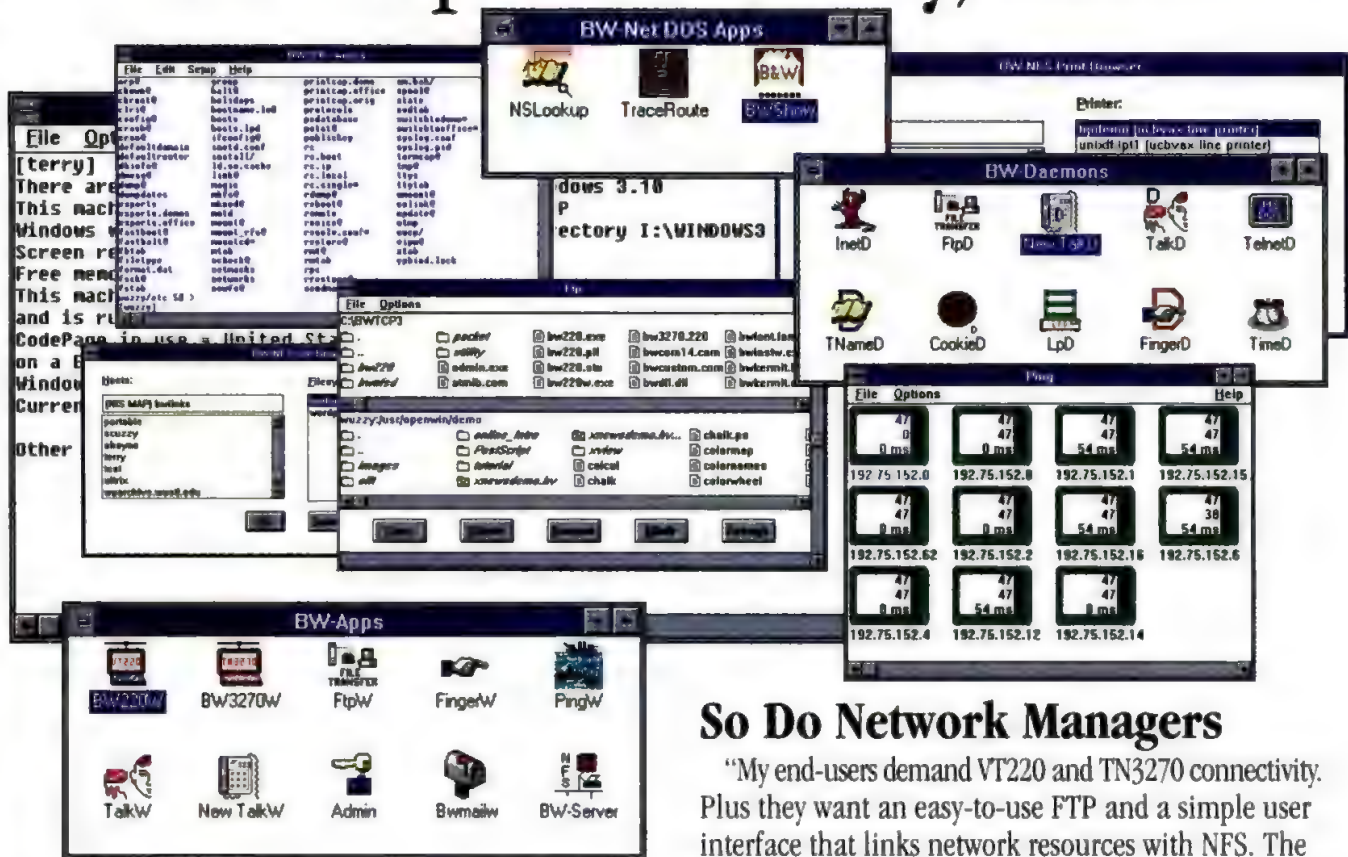
Communications Alternatives



With the LAN Modem or the Communications Server 386 (CS386), you can run applications on a remote PC and on a networked PC. With the CS386, you can also run applications on the unit itself.

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► COMMUNICATIONS

Nuko Makes Sharing Modems Easy

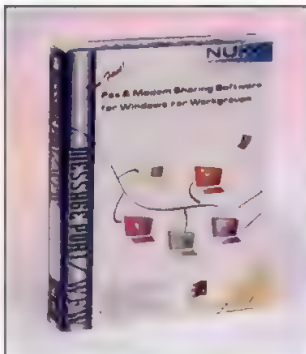
BY STEVE RIGNEY

Thanks to Message Port, Version 1.0, users of low-cost LANs can now share modem and fax capabilities across a network for a fraction of the cost of a network-ready modem. The key is a replacement of the Windows communications driver, which redirects modem signals from the serial port across the network to the PC with the attached modem.

Message Port, Version 1.0, works under Windows for Workgroups and all Windows users of Net-BIOS peer-to-peer LANs. The next version, which should be available by the time you read this, will also support

Novell's NetWare 3.x with Windows. Nuko Information Systems will offer free upgrades.

Message Port includes software that allows you to send, receive, and view faxes, but its most interesting feature is its ability to redirect signals from your PC communications port under Windows. Windows re-established the use of a driver, COMM.DRV, for data communications. Nuko rewrote COMM.DRV to make it into a redirector that sends and receives modem data through the network. Additional software running on each PC acting as a modem server routes data to and from the attached modem.



Message Port turns any modem into a networked modem.

The ability to share modems over a peer-to-peer network will save both time and money. Network modems that provide the same service retail for approximately \$2,000. You can use Message Port with any \$200 to \$300 14,400-bps modem attached to a PC, saving money not only on modems, but also on telephone lines.

However, Message Port does not get around the problem of dropping incoming data from fast modems as networked modems do. If a PC acting as a modem server does not have a high-speed serial port and plenty of processing power, it can lose incoming bits. A networked modem such as the Shiva NetModem/E never loses incoming bits.

If you have the hardware for an efficient modem server, Message Port provides an economical way to share modems across the network.

• List price: *Message Port, Version 1.0*, \$199 (10 user license). Nuko Information Systems Inc., 1609A S. Main St., Milpitas, CA 95035; 800-995-2166, 408-262-2225; fax, 408-262-2261.

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► PROTOCOL ANALYZERS

Distributed Sniffer Gets Expert Analysis

BY TOM KREYCHE AND SRIDHAR PALACHERLA

The latest generation of Network General's protocol analyzer, Distributed Sniffer System, Software Release 2.0 (DSS), combines the power of distributed management with the simplicity of its Expert Analysis system. There are a few omissions in the DSS, most notably the lack of AppleTalk and VINES support and an antiquated DOS management system, but overall it is easy to use and very useful for network maintenance.

Protocol analyzers such as the Sniffer let network managers troubleshoot networking problems by peering inside the LAN and decoding data, accessing a tremendous wealth of information. Sifting through that information is a difficult task, so vendors such as Hewlett-Packard and Network General have developed expert systems. These expert systems have been limited to monitoring only the

network to which they are directly attached. With the Distributed Sniffer, though, network managers can also monitor remote networks.

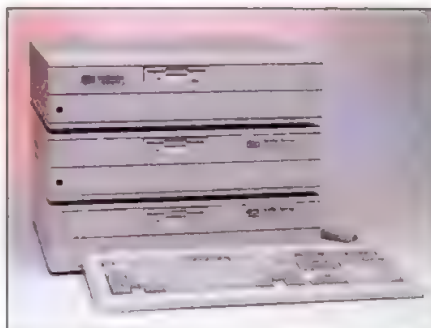
There are two components to the Distributed Sniffer: Sniffer Servers and a SniffMaster control console. Sniffer Servers sit on a network gathering information. The Expert Analysis software running the SniffMaster control console (386/33 PCs running DOS or Sun SPARCstations running X/Windows) analyzes that data. The software automatically identifies any of an array of potential network problems and translates the information into sensible English.

Overall, we found the Expert Analysis software to be far more sophisticated than competing expert systems. It provides a thorough set of features, including the display of network statistics, byte-level packet decoding, filtering of unwanted traffic, and the ability to generate alarms.

We tested the DSS in two different ways; first, in a controlled environment with a local router connecting two net-

works. NetWare servers, workstations, and Sniffer Servers were placed on both segments, checking out basic configuration and operation. We then connected the DSS to a production network while 200 users were busily

engaged in sending e-mail, querying databases, using file and print services, and accessing the Internet. The machines—both Macs and PCs using IP, IPX, and



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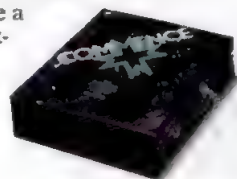
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AppleTalk—were also a portion of a large router-based wide area network.

We captured data in real time using Expert Overview, which shows error statistics for different groups of network resources such as applications, connections, and network stations. These statistics are broken into two categories: abnormal or unusual activity (Symptoms) and faults that require a remedy (Diagnoses). A low error count on a Symptom might be safely ignored, but a high count on a Diagnosis definitely requires further investigation.

During capture, the Sniffer showed applications experiencing a high number of Symptoms. Further investigation showed that many workstations were experiencing low throughput with a file server. Of more concern were the Diagnoses, which showed that a couple of workstations were making repeated requests to the server that were being ignored. We were also able to pinpoint connection-based Symptoms, which showed several pairs of stations experiencing a high number of retransmissions at the transport layer and others with long acknowledgment times. An examination of the Diagnosis for network stations correctly told us that there were paths to stations through multiple routers, since our WAN was designed for redundancy as a partial mesh. The global Symptoms showed us a surprising number of broadcast storms. We half-expected to see questionable alarms, but all the information turned out to be relevant and useful.

DRAWBACKS

The product is certainly not perfect. The most notable problem is the lack of Expert Analysis support for the AppleTalk and VINES. Though the Sniffer does fully decode them, Expert Analysis is really needed for both protocols. Expert Analysis does provide some

information to help manage the network, but that information is not available during real-time capture. This may be annoying but it is not exceptionally serious, since many analyzers give little if any information during capture. It is possible on the DSS since dual network adapters are used—one for capture and one for data transfer.

As for the console itself, the DOS version is pretty easy to use once you are familiar with Network General's menu struc-

ture. Network managers will probably prefer the Sun SPARCstation X/Window version, since it allows you to display results from multiple servers while running an SNMP manager. Unfortunately,

the X/Windows version lacks out-of-band support, without which a network manager can't retrieve information from the probes when the network fails.

A secondary problem is the lack of sought-after RMON support. Still, this software release does allow servers to send Simple Network Management Protocol (SNMP) traps to management stations such as HP's Openview. Network General plans on supporting RMON in the future.

We were also surprised by the hardware design of the servers. They are based on full-size PCs. A smaller box would be better for easier handling and space conservation in tight wiring closets.

• List price: *Ethernet Model 30 Servers*, \$3,500; *DOS version of the console software and network adapter*, \$4995. *Sun version of software*, \$4995. *Network General Corp.*, 4200 Bohannon Dr., Menlo Park, CA 94025; 800-846-6601, 415-688-2700; fax, 415-321-0855.

Circle 967 on reader service card



Network General's Expert Analysis System identifies both network symptoms and alerts the user to urgent problems.

► NETWORK MANAGEMENT

Server Management: Cheap and Pretty

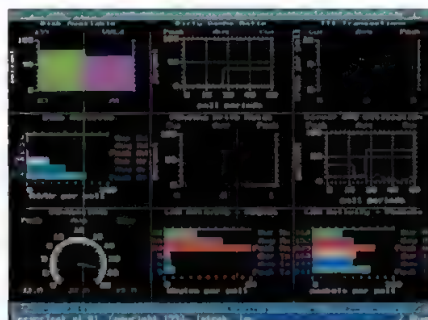
BY PADRAIC BOYLE

Graphics are everything, at least where network management is involved. Yet many NetWare administrators are limited to the difficult and often arcane character-based interface of NetWare's built-in management facilities. For those administrators, ServerTrak will come as a relief. This low-priced management tool (\$149 for one server versus \$495 for Frye Computer Systems Inc.'s NetWare Early Warning System, a similar product) gives a graphical face-lift to NetWare 2.1x and NetWare 3.11. You can view the statistics gathered by Novell's FCONSOLE and Monitor in real-time on a single screen.

But there are drawbacks at this price; features found in products such as NetWare Early Warning System are missing. ServerTrak's diagnostic capabilities are limited and its reporting capabilities are nonexistent, but overall, this is a helpful entry-level network management tool.

The heart of ServerTrak is a DOS-based console that displays information gathered by NetWare's various reporting facilities. It shows information in color bar

charts and scrolling charts and meters; a vast improvement over Novell's archaic management display. The scales are increased dynamically, and most of the displays offer the current, peak, and average statistics. There are two modes in which to view the statistics:



ServerTrak can show nine types of server statistics on one screen. Values are presented graphically as well as numerically.

One supports nine separate windows, and the other shows five small windows and one large window. Both keyboard and mouse can be used to navigate through the windows, and a VGA screen is recommended.

Information is gathered through server-based applications on NetWare 3.11 and on NetWare 2.1x. Statistics such as active connections, dirty cache buffers, disk activity, disk volume availability, and server CPU utilization are among the monitored activities of the file server.

Displaying this information graphically makes managing servers and noticing trends much easier. Having all of the information on a single screen is an even bigger boon. Unfortunately, if you are not familiar with these statistics, ServerTrak will be of little help. Though ServerTrak does offer a brief description of each statistic, it does not offer any explanation as to what the statistic represents. If a server is operating slowly, for example, and the dirty cache ratio and the pending write ratio are both high, ServerTrak won't tell you to add more memory to your server.

Perhaps more importantly, ServerTrak lacks any reporting facilities for comparing present server performance with past server performance. The software also lacks baselining (the ability to determine normal performance). Intrak should fill some of these holes early this summer with the release of two other server-based monitoring products, TrendTrak and PerformanceTrak. TrendTrak is a server-based utility that will perform long-term trends analysis of a file server. PerformanceTrak is a server-based utility that monitors server performance through triggers and statistics.

Without these tools, ServerTrak lacks some critical functionality that network administrators need. Still, with a 30-day money-back guarantee and free unlimited technical support (via a toll-free number), ServerTrak is a strong solution for low-end server monitoring.

• List price: *ServerTrak*: \$149 (single server), \$249 (5 servers), \$449 (10 servers). *Intrak Inc.*, 9999 Business Park Ave., San Diego, CA 92131; 800-233-7494, 619-695-1900; fax, 619-271-4989. Circle 968 on reader service card

► NETWORK OPERATING SYSTEMS

Banyan's ENS Brings Directory Service to NetWare

BY DAVID COBB

Are you tired of managing multiple NetWare servers? Then Banyan Enterprise Network Services (ENS) for NetWare is for you. ENS provides Banyan's VINES' directory services for Novell's NetWare LANs.

ENS for NetWare allows administrators to set up and manage NetWare servers with directory services. Directory services is a single database of all networking elements that allows the user to address each element without knowing the exact location of that element. It also focuses the administration of the network on the network services instead of an individual server. In addition, it allows users to log in to the network rather than to each individual server.

ENS is Banyan's latest attempt to solidify control over the corporate network. While Novell has finally equipped its latest version of NetWare, NetWare 4.0, with its own version of directory services, Banyan has gone one step further. With the latest version of VINES (5.5), ENS, and VINES for Unix, Banyan dramatically enhanced VINES as *the* solution for establishing an enterprise network. (See the related article in this issue, "VINES 5.5 Brings Directory Services to a New Level.")

The client license purchased must be as large as what the locally installed version of NetWare will support. Banyan recommends one ENS server for every eight NetWare servers.

Normally, in a NetWare environment each server must be administered sepa-

ately. A network manager, for instance, needs to add a user to server A in order to give that user access to a corporate database, to server B to grant access to a personal spreadsheet, and to server C to grant access to a print queue servicing the department's laser printer. The administrator must set up an account on each server, granting the appropriate privileges for the user on that server. Then the user

must log in to each server separately using a password for each one.

ENS reduces the amount of time and effort spent in administrating NetWare servers. Service locations can be changed without user impact. ENS forces administrators to stop thinking about

the server and start designing the network around the services it provides. Users will benefit from not having to worry about things like passwords changing on their servers.

With ENS, administration takes place from a single station. The administrator sets up directory names for each service. A user, for example, might be part of the test group at *PC Magazine*. An organization, then, would be defined as PCMAG, with a group named TEST. Services such as printer access and disk volume access would be set up within the group. A user, DAVID, could be assigned to the group TEST with the organization PCMAG (denoted in StreetTalk as DAVID@TEST@PCMAG), and have access to the services without having to know where the services are located. This setup also permits the administrator to change the service location without having to update each user's log-on script or batch files that



Banyan's Enterprise Network Services makes it easy for NetWare users to access network devices.

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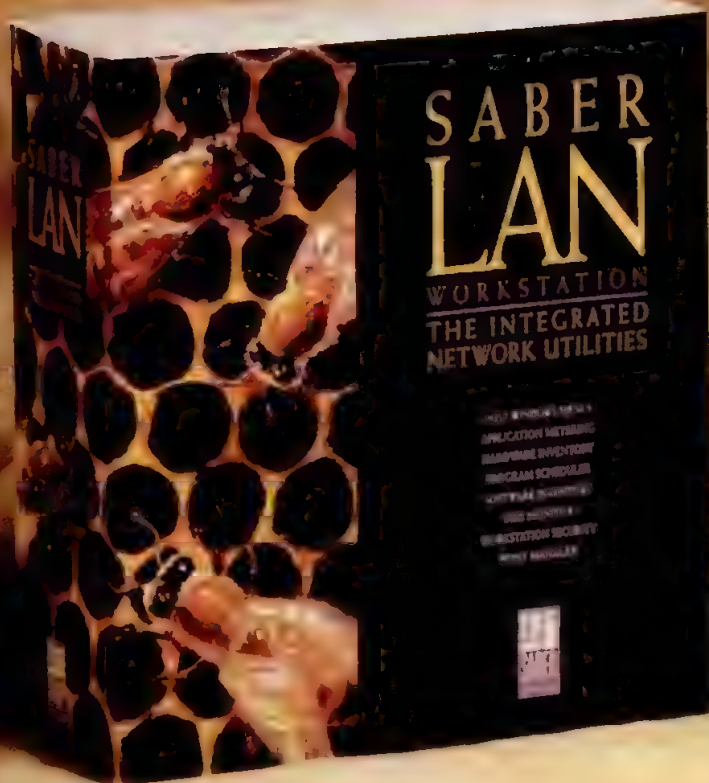
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reference the service. ENS consist of two pieces: the ENS server and the NetWare Loadable Module/value-added process (NLM/VAP). The ENS server is based on Banyan's VINES server. The VINES server stores the services available on the NetWare servers, and acts as the agent for granting access to the NetWare server. The VINES server requires a hardware server key that is attached to LPT1. Note that this key is sensitive to damage from static discharge. During the installation, we found out the hard way and had to get a new key from Banyan.

Setting up the ENS server is a test in patience. Each NetWare requires an NLM/VAP with a license key. The NLM/VAP is very easy to set up. The NLM/VAP communicates with the ENS server to coordinate which services are available. ENS requires a 38K TSR at the workstation and a new log-on and log-out program to access directory services is available for upgrades and support.

ENS for NetWare 1.0 provides an alternative to the often cumbersome task of administering NetWare servers. ENS can reduce the amount of time needed to set up and maintain multiple NetWare servers. If you spend a large amount of time adding and changing users and privileges, this product is worth a look.

• List price: *ENS for NetWare 1.0*: \$295 (5-user license), \$3,495 (250-user license); *ENS server (at least one per network)* \$3,995. Banyan Systems Inc., 120 Flanders Rd., Westboro, MA 01581; 508-898-1000.

Circle 969 on reader service card

► PRINT SERVERS

DirectNet Lets TCP/IP and NetWare Users Share Printers

BY CHARLES KOONTZ

Sharing a printer among TCP/IP and NetWare users used to mean buying a sophisticated multiprotocol, network-ready printer. But with the DirectNet, any HP LaserJet with an MIO or XIO slot can support NetWare and TCP/IP users. And at \$699 for the NetWare/Unix version, that's not a bad deal. A NetWare-only version is \$499.

Installation could hardly be simpler: It took 10 minutes. Slide the card into the MIO slot, and fasten it with two captive knurled screws. You only need a screwdriver to remove the panel that covers the printer's back slot. The DirectNet card has connectors for thin coax and 10BaseT and can sense which connector is active.

Software installation is almost as simple. When using the card with Unix, all you have to do is set the IP address and add a few lines to the system services database, which tracks peripherals on

the network. The manual provides detailed instructions for SunOS, HP-UX, and IBM AIX systems. For NetWare, configuration consists of identifying the print server and its queues. It can function either as a NetWare PSERVER or as an RPRINTER. In

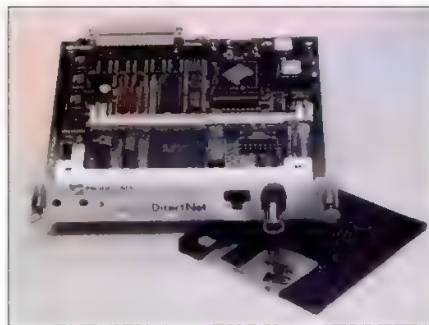
RPRINTER installation, DirectNet must be installed on the same network segment as the file server it is associated with.

Like all dedicated print servers, DirectNet offers a dramatic boost in file-server performance. DirectNet communicates

through the printer's high-speed bus. It can, in theory, sustain much higher speeds than competing products that use the printer's parallel port.

• List price: *DirectNet for NetWare*, \$499; *DirectNet for NetWare/Unix*, \$699. Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121; 619-552-0880; fax, 619-552-0889.

Circle 970 on reader service card



With DirectNet, NetWare and Unix users can share the same printer.

► PRINT SERVERS

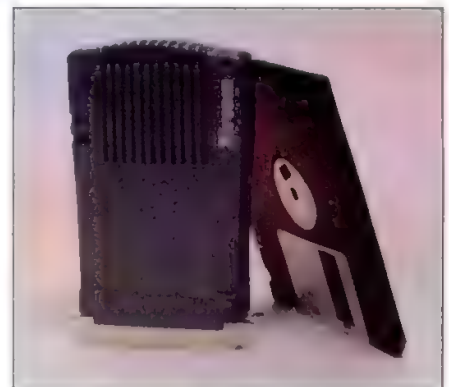
Xircom Offers Portable Print Server

BY CHARLES KOONTZ

The vendor that pioneered pocket adapters has come up with another piece of portable equipment: a print server. Though you might not find much use for the Pocket Ethernet Print Server's (PEPS) portability, you will like its compact size and easy installation routine.

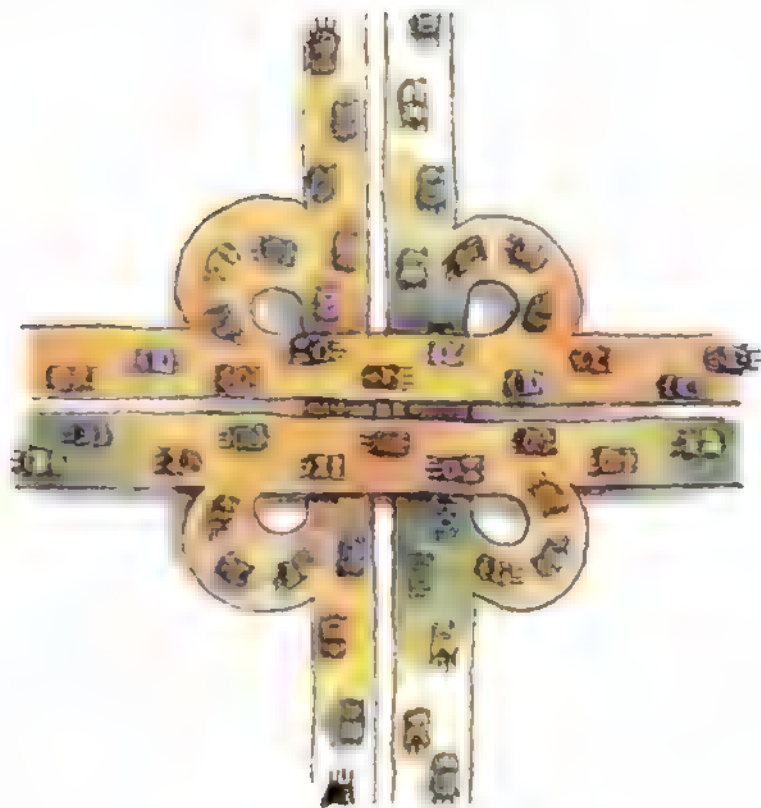
The print server connects any printer to a thin coax or unshielded twisted-pair

Ethernet NetWare 2.x or 3.x network. Like Xircom's other products, PEPS connects with the system through its parallel port. For installation and configuration, you can use either PEPS' simple installation routine or NetWare's PCONSOLE utility. All of the code necessary for connecting the printer to the network runs on PEPS. PEPS can be configured to use the PSERVER NetWare printing utility or the less commonly supported RPRINT-

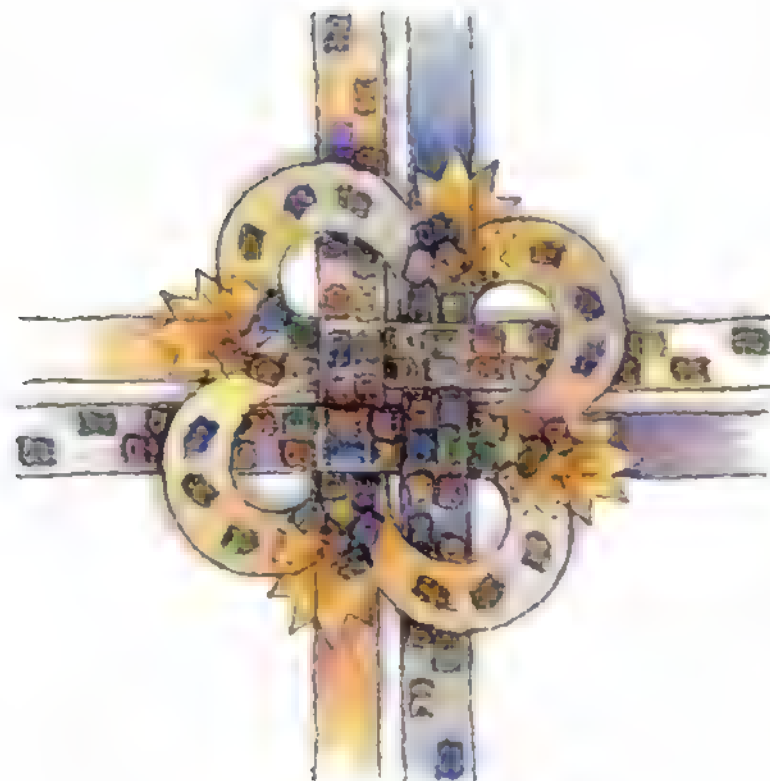


PEPS is a portable print server that fits in your pocket and can still connect a printer anywhere on the network.

M O R E I S L E S S



MORE BANDWIDTH.



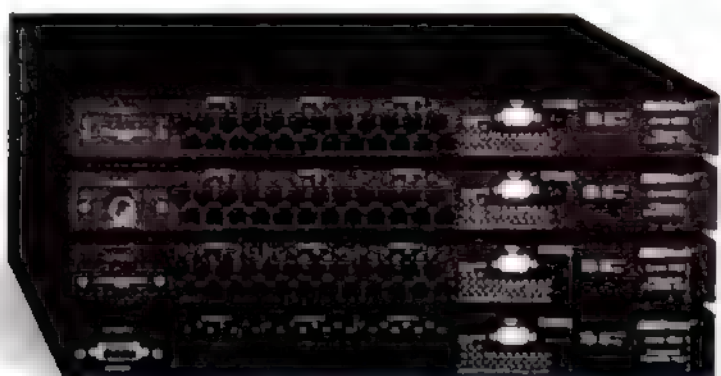
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The TriSegment management hub supports the best management available for a NetWare LAN, Novell Hub Management Interface (HMI), yet it still supports the industry standard, SNMP. Simply, the Series 3000™ line of TriSegment Stackable Hubs lets you design a smaller departmental LAN, a remote office or a sophisticated multi-segment network with the same management and design rules.



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		Ease of Use & Learning	Overall Power	Versatility	Overall Evaluation
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FIRST LOOKS

ER. We tested PEPS as PSERVER on a four-node NetWare 3.11 network with the HP LaserJet 4 as the fourth node.

We found that the installation instructions in the manual are incorrect—you will have to read the READ.ME file on the Xircom floppy disk. You'll also want to be careful with the packaged software: It does not work with a LaserJet 4 yet, although a patch that fixes the problem is available from Xircom's bulletin board system.

Xircom's Pocket Ethernet

*Print Server turns
your old printers into
networked printers
for use with
NetWare 2.x or 3.x.*

When we installed PEPS on an old Unisys Model 27 printer, PEPS worked well.

The only other drawback is that it sticks straight out from the back of the printer. With a coax connector, the unit adds 5 inches to the depth of the printer. Other larger print servers use a connectable cable instead.

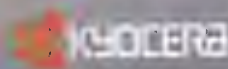
The unit's performance was pretty good. We printed a WordPerfect 5.2 for Windows document using Adobe Type Manager to control the typefaces. Without PEPS, and with PSERVER on the file server, server utilization was 40 percent. With PEPS, the same print job scored only 11 percent server utilization; just right for an external print server.

If you want to turn an old but still-serviceable printer into a network workhorse, the Xircom Pocket Ethernet Print Server can do the job. At the price, it's a bargain. You can get an even better deal if you already own a Xircom adapter: Trade it in for a 50 percent discount on this new unit. Xircom products carry a two-year unconditional guarantee.

• List price: *Pocket Ethernet Print Server*, \$499. Xircom Inc., 26025 Mureau Rd., Calabasas, CA 91302; 800-438-4526, 818-878 7600; fax, (818) 878-7630. Circle 971 on reader service card

NE42 PC MAGAZINE JUNE 29, 1993

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Kyocera Electronics Inc.
130 Exchange Road, Paramus, NY 10765

**Ecosys
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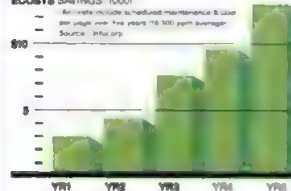
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FS-3500A 18 ppm



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► NETWORK ADAPTERS

IBM MC 32: High-Performance Token-Ring at a Reasonable Price

BY TONY POMPLI

IBM's new Token-Ring server adapter, the LAN-Streamer MC 32, hits the spot for high-throughput applications without ripping a hole in a LAN administrator's budget. Priced at \$860, the card rivals the fastest Micro Channel architecture (MCA) Token-Ring cards, including Madge's Smart 16/4 MC32 Ringnode.

The LAN-Streamer is one of the first IBM products to feature the company's new LANStreamer chip set. It also offers enhanced direct memory access (DMA) and support for IBM's Streaming Data Procedure (SDP). SDP lets the adapter move data more efficiently between the adapter port and system memory. With its focus on bus efficiency, LANStreamer is aimed at the server market.

In *PC Magazine's* 16MB, IPX LAN testing, we found that the card ran neck and neck with Madge's Ringnode, pumping 4K packets at a rate of 15.394 Mbps compared with the Madge's 15.379 Mbps. Both cards also performed equally well when running smaller, 64-byte packets; the IBM card achieved a throughput of 2.454 Mbps, while the Madge provided a respectable 2.356 Mbps.

The LANStreamer does eat up more server resources than the Madge card, using 64.6 percent of the server's processor resources when transmitting 64-byte



Benchmark Tests: IBM LANStreamer MC 32

The IBM LANStreamer MC 32—a Token-Ring adapter—is a competitive performer against existing high-speed, 32-bit server adapters such as Madge Networks' Smart 16/4 MC32 Ringnode. The LANStreamer uses a new chip set from IBM that supports improved direct memory access (DMA) as well as the Streaming Data Procedure (SDP) introduced on the IBM PS/2 Model 95, enabling data transfer rates of up to 40 megabits per second. Although performance was very good, the streaming feature added little to the throughput in ZD Labs' tests. The adapter also required more CPU time on the server when sending smaller blocks.

Network Throughput (Megabits per second)

	Block size						
	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
Madge FastMac	1.43	2.75	5.07	7.16	10.81	14.75	14.86
Madge FastMacPlus	2.36	4.33	7.50	11.52	13.74	14.80	15.38
IBM LANStreamer MC 32 (streaming on)	2.44	4.58	7.98	11.24	13.76	14.80	15.19
IBM LANStreamer MC 32 (streaming off)	2.45	4.55	8.00	11.13	13.78	14.82	15.39

Higher scores represent better performance

CPU Utilization (Percentage)

	Block size						
	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
Madge FastMac	42.14	44.50	48.40	31.10	26.00	21.00	14.80
Madge FastMacPlus	40.57	43.00	46.40	34.40	27.15	20.00	16.00
IBM LANStreamer MC 32 (streaming on)	64.60	62.30	55.55	41.40	30.20	20.20	14.80
IBM LANStreamer MC 32 (streaming off)	64.40	60.60	55.50	41.30	31.10	21.20	16.20

Lower scores represent better performance

Performance Index (Network Throughput/CPU Utilization) (Ratio)

	Block size						
	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
Madge FastMac	0.21	0.39	0.65	1.44	2.60	4.39	6.27
Madge FastMacPlus	0.36	0.61	1.01	2.09	3.16	4.62	6.01
IBM LANStreamer MC 32 (streaming on)	0.24	0.46	0.90	1.70	2.85	4.58	6.41
IBM LANStreamer MC 32 (streaming off)	0.24	0.47	0.90	1.68	2.77	4.37	5.94

Higher scores represent better performance

packets, compared with Madge's 40.7 percent. This might make the LANStreamer less useful in applications frequently updating small amounts of data.

The card comes with server drivers, including those that adhere to Novell's Open Data-Link Interface (ODI) specification and Microsoft's Network Driver

Interface Specification (NDIS). Client drivers are expected later this year, according to IBM.

Expect to see more from the LAN-Streamer line, including a 16-bit version scheduled for release later this year. For now, network managers will find the LAN-Streamer to be a hot buy for their high-speed MCA servers.

• List price: **IBM LANStreamer MC 32, \$860.** IBM Corp., Old Orchard Rd., Armonk, NY 10504; 800-426-3333, 914-765-1900; fax, 914-765-4190. Circle 975 on reader service card

► WIRING HUBS

Stackable Hubs Meet Token-Ring

BY JEFFREY L. CARRELL

Do you want to manage your token-ring network centrally, but can't afford a high-priced intelligent hub? Then StarTek Inc.'s LinkBuilder TRi series of Token-Ring hubs may just be the solution.

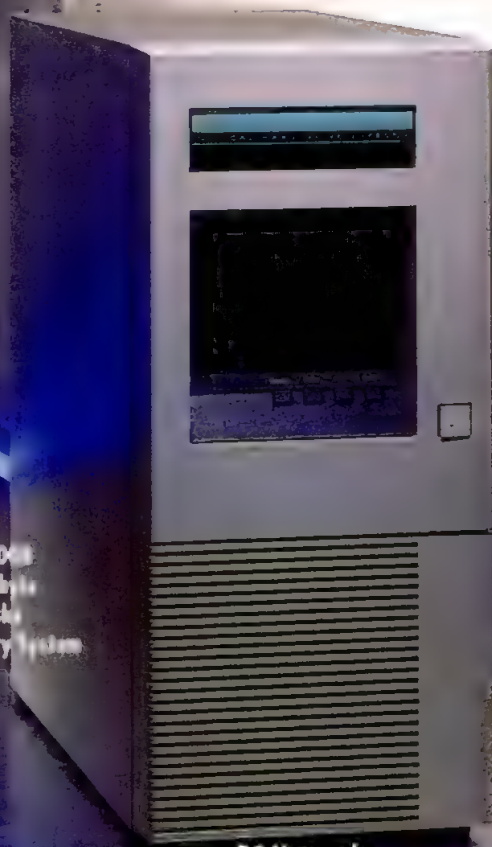
The new LinkBuilder TRi series hubs is the first stackable hub for the Token-Ring market. Stackable hubs garnered great popularity among Ethernet vendors primarily because of their lower cost of entry. With a stackable hub, network managers can purchase cheaper unmanageable hubs



StarTek's new stackable Token-Ring hub offers impressive features, including SNMP management, at an affordable price.

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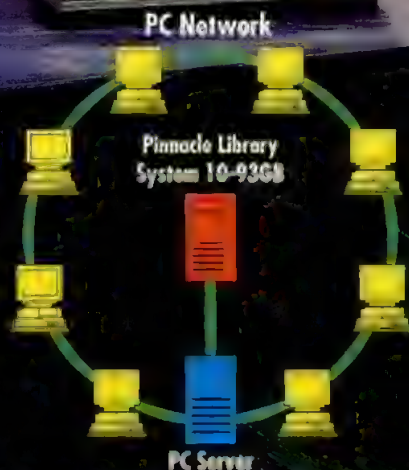
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Have You Ever Wanted To Leap Out The Nearest Window?

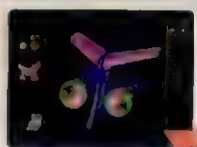
Take The Plunge With Proxy. It's Network Remote Control For Windows, From Windows.

Some things you expect in remote control software. Like lightning-fast speed. And control over both DOS and Windows on the host PC. But new Proxy gives you something you probably don't expect. Because it not only works with Windows, it works from Windows. And that makes all the difference.

You see, other remote control products run from DOS, even



Proxy supports host computers running Windows.



If it runs on the host, it runs in a Proxy window. Even graphical DOS programs.



You can connect to multiple PCs over a network, with each appearing in its own window.

those that support a host running Windows. So they allow just one connection at a time, and demand total attention from your computer. But Proxy is a Windows application that lets you make multiple connections simultaneously. You can display and control a different host PC in each window you open, while you continue to run local applications.

Users Calling For Help? Leap Out The Nearest Window.

If your job is to help users on the network, Proxy will make it easier.



Run time-consuming jobs on dedicated processors, and control them all from Proxy.

No need to abandon your own work when someone calls. Just click on a Proxy icon and instantly connect to the caller's machine. You now have full control of their hardware and software, complete with mouse and keyboard support, whether

they're running Windows or DOS.

Reconfiguring Lots of Workstations? Leap Out The Nearest Window.

Now you can perform administrative chores like software installation, updates, and system configuration without going from room to room. Just capture a PC and perform any operation as if you were sitting in front of it.

You can even reboot it remotely!



Proxy gives you complete control of any computer on the network.

Need More Processing Power? Leap Out The Nearest Window.

Imagine off-loading your most CPU-intensive tasks to separate machines you control as if they were part of your own desktop. Imagine two, three, or more applications, each running at full speed because each has its own dedicated processor. That's the power of multi-processing with Proxy.

You can make Proxy available across the network and give power-hungry users access to spare or idle PCs. You can even dedicate PCs to specific tasks, like a high-powered 486 for CAD or a modem-equipped 286 for communications.

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Get the most advanced network remote control available, with applications ranging from user support to multi-processing. Get Proxy. It's from Funk Software. The same people who brought you Sideways®, Always, and other top-selling PC utilities.

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PROXY™

CIRCLE 870 ON READER SERVICE CARD

**FUNK
SOFTWARE**

System Requirements: Proxy "Master" runs in Windows and can control multiple "Hosts" running DOS or Windows over an IPX network (e.g. NetWare).

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Funk Software, 222 Third Street, Cambridge, MA 02142 Tel (617) 497-6339 Fax (617) 547-1031

and then add management later.

The LinkBuilder TRi comes in different configurations ranging from 16 to 256 ports. All the hubs are fully manageable via any management station running Simple Network Management Protocol (SNMP) or Star-Tek's Network Management Software, Version 2.1 (STNM). By supplying RMON (Remote Network Monitoring) support, each hub becomes a mini protocol analyzer, allowing you to gather a tremendous wealth of network information.

STNM runs on OS/2 and displays the information collected at the hub. Many management features are provided with STNM, including real-time graphs of network traffic and the status of an individual hub. Management is available in either In-Band (management console connected directly to the LAN) or Out-of-Band (management console connected to the SNMP hub via a dial-up connection) connections.

In addition to SNMP and RMON management, all LinkBuilder TR and TRi hubs have built-in fault isolation functions. If an error condition occurs, Zero Delay Lockout (ZDL) provides automatic lockout of a station trying to connect. For example, when a station tries to enter the ring at the incorrect speed (4MB instead of the 16MB your network is using, for example), that port is locked out before that station ever gets into the ring to cause problems.

We also found that the hub isolated high traffic loads. Thanks to the hub's built-in features and STNM alerts and filters, the ring didn't fail.

The new LinkBuilder TRi hubs combined with the STNM software offer industry standard SNMP management and new Token-Ring RMON capabilities for an affordable price.

• List price: *LinkBuilder TR (16-port TR Hub for UTP/STP)*, \$2,595; *LinkBuilder TRi Model 1 (LinkBuilder TR with Advanced SNMP Agent)*, \$4,395; *LinkBuilder TRi Model 2 (LinkBuilder TR with SNMP RMON Agent)*, \$5,195; *STNM 2.1 network management software with RMON support*, \$2,995. Star-Tek Inc., 71 Lyman St., Northboro, MA 01532; 800-NET-3COM, 508-393-9393; fax, 508-393-6934. Circle 976 on the reader service card

► COMMUNICATIONS

DigiBoard Gets Serious About ISDN

BY FRANK J. DERFLER, JR.

Thanks to DigiBoard's PC IMAC, any PC running under NetWare 3.11 can take advantage of an ISDN connection. The PC IMAC is the first easy-to-use PC adapter for Integrated Services Digital Network (ISDN)—the specification for the digital phone network. No longer do users need to contend with the cryptic Hayes command set to establish an ISDN link: A special driver handles the communications, freeing the user to transfer files as if they were on the same network.

The \$995 PC IMAC (ISDN Media Access Control-layer) adapter is a small Industry Standard Architecture (ISA) adapter card equipped with a digital signal processor (DSP) and 200K of RAM. With a DSP, much of the processing is offloaded from the PC's CPU to the adapter, so you can continue using your applications while receiving files across ISDN in the background.

Currently, those files must be on a NetWare 3.11 network. DigiBoard doesn't yet ship NetWare server software for the PC IMAC. The company does, however, offer a bridge for connecting a NetWare server to an ISDN network, allowing a PC equipped with the PC IMAC to access the server's files. A driver for Open Data-link Interface (ODI), the NetWare specification for addressing interface adapters, makes the PC IMAC appear to be a LAN adapter to such a PC. Unlike other LAN adapters, however, this ODI driver maps a drive letter to an ISDN telephone number. Sending a file to an attached ISDN machine, then, is as simple as copying data to a network drive. The ODI driver initiates an ISDN call, establishes a connection with the remote PC, and transfers the data. The driver consumes 37K, but can be loaded high under DOS 6.

The word *call* is misleading. Unlike voice telephone calls, ISDN calls initiate and connect in milliseconds, not seconds. Calling is similar to accessing an open circuit offering a 128-Kbps connection, just

perfect for applications such as electronic mail, other periodic file transfers, and point-of-sale actions such as checking credit cards. But an ISDN link is less appealing for full-time on-line transaction processing because leased telephone lines will probably be more economical.

EASY INSTALLATION, DECENT PERFORMANCE

If you know how to install a LAN adapter, installing the PC IMAC in the PC is a trivial task. DigiBoard provides options for selecting specific AT&T or Northern Telecom ISDN switches, or any telephone switches conforming to National ISDN1 standards. You'll need to have specific terminal and line-ID information in hand when you configure the software, but the information you need should come when you order ISDN service.

During our tests, we opened and saved word processing files contained on a networked drive. Doing a DIR of the F: drive had the same effect. A pause told us that we weren't on a LAN or local drive, but DigiBoard's software data compression can provide throughput of 256 kilobits or better, so the response was good, though for the sake of time, we didn't want to load the applications across the two 64 kilobit parallel links.

DigiBoard is leading the ISDN PC pack, but others aren't far behind. Digital Equipment Corp. recently rolled out the DEC ISDN PCSO for DECnet or TCP/IP, which delivers similar functionality, for over \$1,500. ISDN Systems Corp. plans delivery of FX-BRI, which will compete directly with DigiBoard's PC IMAC, for the second quarter of 1993. Announcements are expected from other major vendors as well.

ISDN LAN links aren't available everywhere in the U.S. yet. But if you get the service, DigiBoard's IMAC is for you.

• List price: *PC IMAC*, \$995. DigiBoard Inc., 6400 Flying Cloud Dr., Eden Prairie, MN 55344; 800-344-4273, 612-943-9020; fax, 612-943-5398.

Circle 977 on reader service card



YOU'LL SWEAR IT RUNS ON JET FUEL.

The fileserver on the right was recently tested against the one on the left for data throughput on a 28-user Novell® network:

While the Compaq Prosignia with IDA-2 managed a 173 overall score, the Dell® 4066/XE DSA SCSI-2 scored an unbelievable 413.

Over *twice* the throughput.

Frankly, we were surprised we didn't come out even faster. Considering that we had a rather unfair advantage.

We call it the Dell SCSI Array. The DSA, for short.

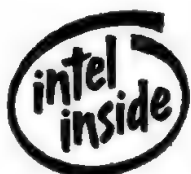
It delivers up to 138% more performance than Compaq's IDA-2 drive array, thanks to advanced technology including an i960™ RISC processor and two SCSI-2 channels on the controller. And the more drives you add, the better the throughput.

But the Dell 4066/XE DSA server isn't merely fast; it has the storage expansion capabilities to go with that speed.

THE DELL 4066/XE DSA
i486™ DX2 66MHz SYSTEM

\$14,805

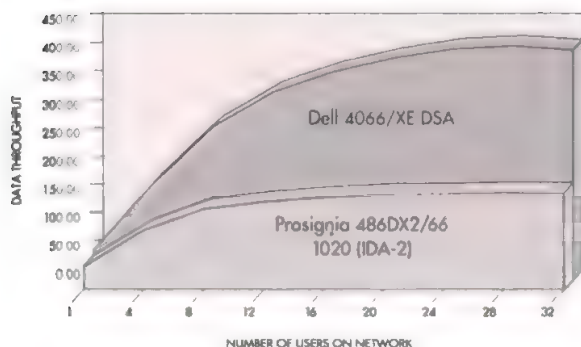
- Business Lease*: \$530/MO.
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 - 4 x 1GB SCSI-2 Drives (9.5ms)
 - Upgradeable to Pentium™ Technology
 - 8 EISA Expansion Slots (6 available)
 - VGA 800 Monitor
 - One Diskette Drive (3.5" or 5.25")
 - Eagle Technology NE3200 EISA (available from Dell)
- Disk Mirroring and Duplexing also available, not included in price featured.
- Tested system included an additional 3 Eagle cards for an extra \$2,325.



*Testing independently audited by Bounds, Chatelain and Pharr. For detailed test results call TechFax™ at 1-800-950-1329. *Prices valid in U.S. only. Some products On-site service may not be available in certain remote areas. The Intel Inside logo is a registered trademark and i486 and i960 are trademarks of Intel Corporation. Novell is a



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IN MEXICO CITY: 228-7811.

► SWITCHES

NSI Boosts Ethernet Performance

ROBERT LIPSCHUTZ

Early adopters of Ethernet switches now have something to smile about. A new application lets you dramatically improve your NetWare 3.11 server's throughput. Balance NLM, Version 1.0, from Network Specialists Inc. (NSI), lets you connect your NetWare 3.11 server and Ethernet switch with multiple network adapters. With more networks, adapter file servers have more bandwidth to service clients.

Prior to the release of Balance NLM, NetWare 3.11 servers could only sustain a single connection between a server and a switch, like Kalpana's EtherSwitch. Balance NLM makes multiple connections appear as a single connection to a NetWare server. It handles IPX and AppleTalk packets.

Normally, networks are designed around a hub. Each port on the hub is connected in a single network. With a switch-based network, the hub is replaced by a high-speed switch. Instead of all ports functioning as one network, each port is a separate network. Thus, a ten-port switch can connect ten Ethernet networks for 50Mb of bandwidth.

Those stations that require more bandwidth can be placed on a network with fewer stations. In the extreme case, they might be the only station operating on the network, giving them up to 10Mb of bandwidth.

Most clients don't need 10Mb of bandwidth. However, there are some nodes, such as commonly accessed field servers, that demand higher capacity. They are accessed by so many simultaneous users. And though with a switch-based network, you can devote 10Mbps to the server, even that may not be enough.

The Balance NLM allows you to devote more bandwidth where it's needed: the NetWare server. Usually, a NetWare 3.11 server automatically routes packets between its network adapters. This prohibits multiple connections to the same network. The

Balance NLM turns multiple physical network adapters into a single high-bandwidth network card. Need more bandwidth? Just add another network adapter.

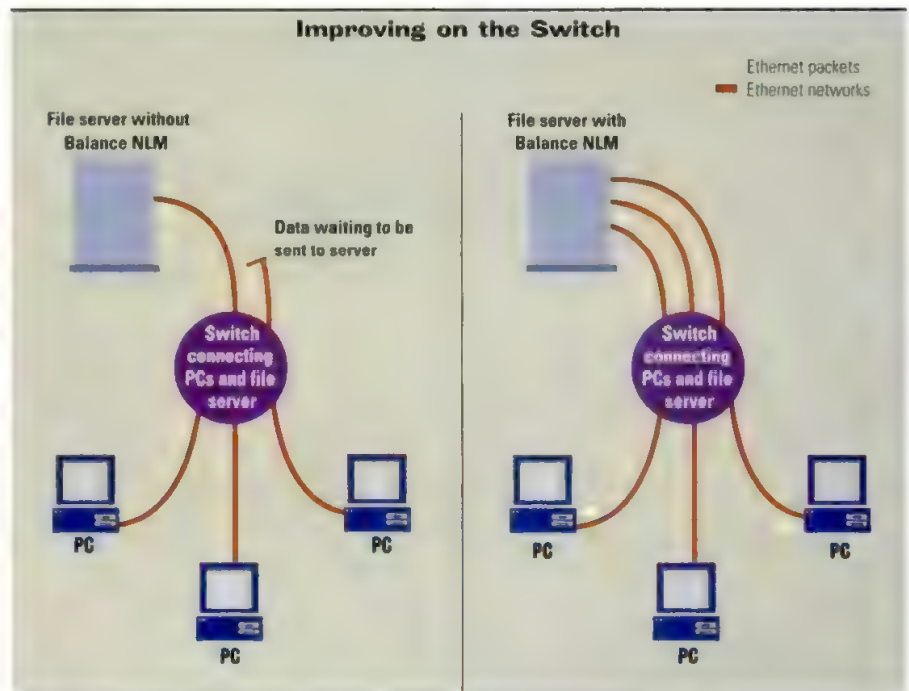
Sure enough, that's exactly what we found during our testing. As we added Ethernet cards, the performance increased proportionally. Two cards gave twice the performance with both small and large packet sizes, and four cards also gave appreciable performance gains over two cards.

There is a premium on this kind of performance both in terms of CPU resources used and in terms of the actual price tag. As you increase the number of

tested with the Kalpana EtherSwitch, any switch or multiport bridge or router should work. The Kalpana EtherSwitch costs \$2,000 plus an additional \$875 per port for the high-end 15-port model (\$1,075 per port for a 10-port device) and \$3,500 for the 5-port 10BaseT model (\$700 per port). However, this solution is still much cheaper than going completely with FDDI.

The Balance NLM comes with a statistics module (STATS.NLM) that shows statistics about the boards that are being balanced by the Balance NLM. The interface is quite crude, but the module does give useful information on transmitted and received packets and CPU utilization.

The Balance NLM used in conjunction with the Kalpana EtherSwitch gives a high performance alternative to traditional concentrator-based NetWare net-



With Balance NLM, a server has more bandwidth to send and receive data.

packets a given server must process, you also consume more server resources. Balance NLM is no different. Even though it will allow more throughput, your CPU will show the signs of wear and tear.

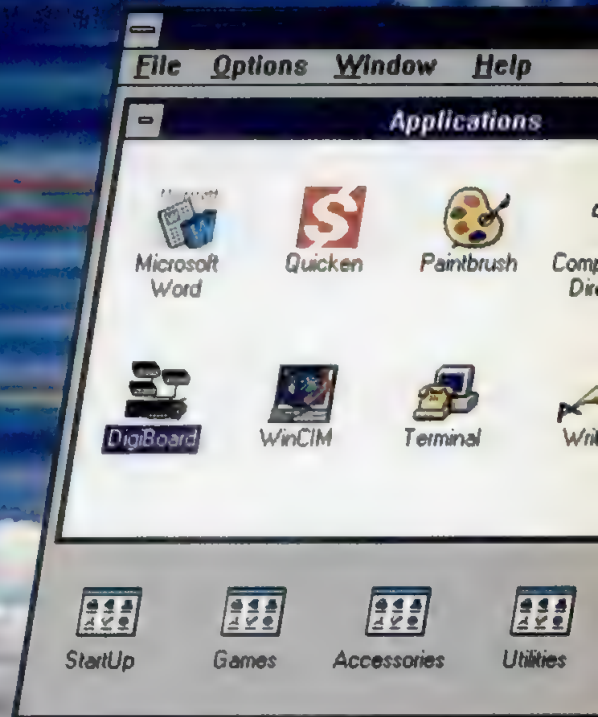
The overall price tag on this performance can also be fairly high. You will need to purchase a switch. Though we

works. If you have a network with heavy traffic, then Balance NLM may be for you.

• List price: *Balance NLM, Version 1.0*, \$2,495 per server. Network Specialists Inc., 1099 Wall St. West, Lyndhurst, NJ; 800-775-4674, 201-804-8400; fax, 201-804-2799.

Circle 978 on reader service card

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*PC Week, July 1992. Lab test of a 386-based PC running Windows 3.1

CIRCLE 854 ON READER SERVICE CARD

► NETWORK OPERATING SYSTEMS

VINES 5.5 Brings Directory Services To a New Level, Launching New Strategy

BY DAVE MEYER

While NetWare 4.0 captures the hearts of Novell customers, VINES 5.5 may give them something to think about. This latest version of the powerful network operating system not only unites the functionality of two earlier versions of VINES but introduces StreetTalk III, an update of Banyan's much-heralded directory services.

VINES 5.5 reasserts Banyan as the dominant supplier of enterprise backbones. It is the first part of a three-prong strategy by Banyan to provide a cohesive framework for tying together VINES, NetWare, and Unix clients, counteracting Novell's push into enterprise net-

working. For NetWare users, Banyan supplies its Enterprise Network Services (ENS) (see "Banyan's ENS Brings Directory Service to NetWare" in this issue), the second prong of this strategy: ENS offers StreetTalk directory services and messaging to NetWare. For Unix users, Banyan supplies a third product, Open VINES for Unix, which improves VINES' Unix client and server connectivity.

VINES 5.5 supports Windows for Workgroups (WFW), but that support is rudimentary, since neither Microsoft Mail nor Schedule+, provided with WFW, currently use StreetTalk naming.

Banyan also enhanced client support by adding stations running OS/2 2.0.

Windows support is significantly improved. Now under VINES 5.5, users can log in and out of the network without exiting Windows. Printer management is also now more tightly integrated into Windows. Users, for example, can now use Print Manager to view and control network print jobs.

StreetTalk III ties these components together, providing all features of the network with consistent names that are independent of location. This lets users log in to the network once and access services that may be spread across the entire network. Users can modify their view of the network through StreetTalk on the fly, accessing files by name without knowing their precise location. Banyan's made several enhancements to StreetTalk. The most important is the ability to add attributes to any individual StreetTalk entry. Some attributes can define unique characteristics for a given mail address. They might hold an X.400 mail address, work specialization, or even a recent photograph of the user.

Should you buy a hub that suits you plan for



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you can start with a single hub and grow into a stack that is just one logical repeater.

When you're ready for management, instead of buying an entire managed box, you can just plug an SNMP management module into the back of any LinkBuilder FMS hub. This will automatically add management to every hub in the stack. You

Attributes can even hold X.500 information about each StreetTalk item. This helps allow the directory services of VINES and an X.500-based system such as NetWare 4.0 to interoperate. Banyan provides a standard set of attribute definitions to insure standardization for widely used attributes.

Managing StreetTalk III is also easier than in previous versions. StreetTalk Users and Lists can now be renamed or moved under VINES. Additionally, StreetTalk groups can now be moved on-line from one server to another.

Using the StreetTalk III services is an enhanced client-server Banyan Mail program, now known as Intelligent Messaging (IM). The changes include unlimited message size, configurable delivery prior-

ities, and configurable expiration.

Other assorted goodies include support for both full T1 and ISDN server-to-server communications. Both new WAN communications options require new optional interface cards. These new capabilities round out the wide array of WAN protocols supported by VINES at the server level.

The VINES documentation was completely rewritten for Version 5.5. It is so much improved that VINES users should consider purchasing it separately even if they choose not to upgrade immediately to VINES 5.5. The documentation may, however, be all that you can afford of VINES 5.5 if you are a VINES 4.x user.

VINES 5.5 brings enterprise networking to a new plateau for VINES users.

Banyan's StreetTalk III has refinements that will satisfy nearly any conceivable directory service requirement and provides the basis for future directory services interoperability. The VINES 5.5 Intelligent Messaging option offers major enhancements to their already powerful messaging engine.

Banyan's efforts both with VINES 5.5 and ENS also provide a bold first step toward NOS interoperability with NetWare. The ultimate success of VINES 5.5, though, will likely be decided as much by the acceptance of Banyan's ENS for NetWare as by the features provided in VINES 5.5 itself. Without providing NetWare users with a simple migration path from NetWare to VINES, Banyan cannot hope to greatly increase its relatively small market share.

•List price: VINES 5.5, \$5,495; Upgrade from 4.x, \$5,520; Upgrade from 5.0 \$3,828; Banyan Systems Inc., 120 Flanders Rd., Westboro, MA 01581; 508-898-1000.

Circle 979 on reader service card



StreetTalk III makes VINES X.500-compliant.

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Add management.



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What's more, if you buy any three FMS hubs you can get a management module for \$199*—a savings of \$700.

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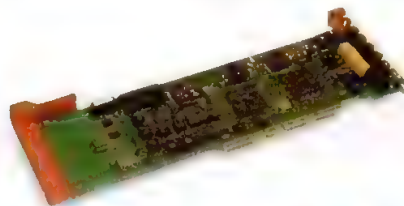
can take advantage of enhanced Madge technology, free. You not only get the best in Token Ring solutions today, you get the platform for the best in Token Ring technology tomorrow.

Fastest.

At 30,000 frames per second, the Smart MC32 delivers the highest Token Ring performance in the industry. You simply can't go any faster.

Put your Token Ring network on the fast track to the future with Smart 16/4 MC32 Ringnodes from Madge.

Call 1-800-TR-Madge (1-800-876-2343).



Smart Networking



It runs with NetWare

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CIRCLE 877 ON READER SERVICE CARD

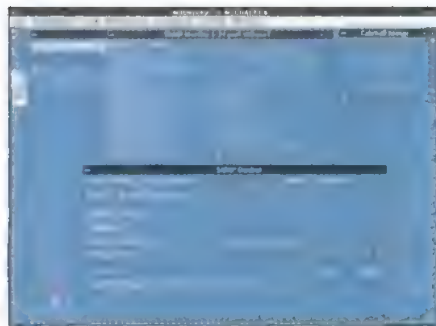
NEW & IMPROVED

NEWS OF ANNOUNCED NETWORK PRODUCTS AND UPGRADES

NEW & IMPROVED

UB Cuts Hub Prices and Improves Network Management

In an effort to increase its presence in the corporate-network market, Ungermann-Bass released a new high-density Ethernet concentrator and an enhanced network management package. The new package touts more complete statistics, alarm information, and security. The company also cut prices across its entire product line. Its 30-percent cuts to 10BaseT and FDDI prices make those prices among the lowest in the industry.



UB's scalable three-tiered network management architecture allows functions to be added as the need arises.

UB's newest 10BaseT concentrator, the ASM324T—a 24-port, RISC-based hub—is one of the first hubs to support the IEEE 802.1F standard for Thresholds and Gauges, allowing managers to create up to 39 gauges with parameters to monitor performance and network faults and address statistics down to an individual port. These features will be available for the first time on the ASM324T and can be activated by a password from an Access/One Manager or any management station based on Simple Network Management Protocol (SNMP). Existing 12-port modules will require a daughterboard upgrade.

The ASM324T also provides enhanced security. The new security software implements UB's newly patented Network Message Security Method and Apparatus technology. The software provides protection against eavesdropping (ensuring that data is sent only to authorized destinations) and against intrusion (preventing unauthorized devices from logging onto the network).

• List price: ASM324T, \$2,250. Ungermann-Bass Inc., 3900 Freedom Circle, Santa Clara, CA 95052-8030; 800-777-4LAN, 408-970-7386.

Circle 951 on reader service card

NEW

JetFax MIO Allows HP LaserJet 4 Laser Printers to Fax

JetFax MIO makes plain-paper faxing simple: Just plug the fax card into the Hewlett-Packard LaserJet 4's MIO slot, and users of most network operating systems—including NetWare, LANtastic, and LAN Manager—can now send faxes.

The JetFax MIO, which ships with DOS and Windows software, offers a range of features including custom cover pages, custom mail-merge, and delayed broadcasting.

Incoming faxes are printed on plain paper and are stored in memory when the printer is out of paper. JetFax's 256K of memory can store roughly 15 fax pages. Upgrades of 1MB (supporting 60 pages) and 4MB (supporting 240 pages) are available.

• List price: JetFax MIO, \$399. JetFax Inc., 978 Hamilton Court, Menlo Park, CA 94025-1430; 800-753-8329, 415-324-0600; fax, 415-236-6003.

Circle 952 on reader service card

HOT PROSPECT

Network Peripherals Ships FDDI-UTP Adapter



Network Peripherals has become the first firm to deliver a product based on the new Fiber Distributed Data Interface over Unshielded Twisted-Pair (FDDI-UTP) draft standard. Its adapter frees up data-intensive applications on Ethernet and Token-Ring LANs.

The high cost and difficulty of implementing fiber-optic cable and adapters have been major impediments to the widespread adoption of the 100-Mbps FDDI standard. Network Peripherals' conformance to the newly adopted ANSI FDDI-UTP standard and adapter prices below \$1,000 may signal a new wave of high-speed LANs. Adapter cards are available for SBus with drivers for SunOS and Solaris 2.1 and for ISA, EISA, and MCA buses with drivers for NetWare and LAN Manager.

Network Peripherals tested these cards with its own hubs as well as with SynOptics Communications' newly announced standards-based FDDI-UTP hubs.

• List price: FDDI UTP adapters: SBus and ISA, \$995; EISA and MCA, \$1,495. Network Peripherals, 1371 McCarthy Blvd., Milpitas, CA 95035; 408-321-7300; fax, 408-321-9218.

Circle 966 on reader service card

NEW

Proxim Ships First PCMCIA Wireless LAN Adapter

Proxim, a major supplier of wireless networking products, began shipping the first PCMCIA wireless LAN adapter, the RangeLAN/PCMCIA. With Type II PCMCIA, the adapter will enable PCMCIA-equipped laptop and notebook computers to easily share data with corporate LANs without wired connections.



RangeLAN/PCMCIA is the first wireless LAN adapter for Type II PCMCIA slots.

The PCMCIA adapter joins Proxim's family of wireless adapters, which includes adapters for the AT bus, the Compaq LTE, the Compaq Contura notebook, and for the parallel port of any computer. All RangeLAN wireless network adapters use spread-spectrum radio-frequency technology. The RangeLAN/PCMCIA has an indoor range of 300 to 500 feet. Data is transferred at 242 Kbps. Proxim provides drivers for NetWare 2.x, 3.x, NetWare Lite, and cards supporting the NDIS standard.

• List price: RangeLAN/PCMCIA, \$595. Proxim Inc., 295 N. Bernardo Ave., Mountain View, CA 94043; 800-229-1630, 415-960-1630; fax, 415-964-5181.

Circle 953 on reader service card

NEW

Soltek Offers Comprehensive Wireless LAN Solution

Soltek began shipping a broad line of wireless LAN products that link not only PCs but Ethernet workgroups as well. Using spread-spectrum radio-frequency technology, the new Soltek products provide data-transfer rates up to 2 Mbps.

The AirLAN/Bridge Ethernet bridge provides wireless connectivity among Ethernet LANs in different locations. It resides on an Ethernet segment and with the included omnidirectional antenna can communicate with another segment up to 500 feet away. Optional antennae that provide connectivity to a LAN up to 3 miles away are available.

AirLAN/Hub provides connectivity for all wireless workstations into an Ethernet network. It is packaged in the same chassis as the AirLAN/Bridge and includes an antenna with a range up to 800 feet. Each AirLAN/Hub provides network connections for thin Ethernet coax and 10BaseT.

The third product, AirLAN/Internal, is an Industry Standard Architecture (ISA) or Micro Channel architecture (MCA) adapter card that comes with network workstation drivers and an omnidirectional antenna. NetWare (2.x, 3.x, and Lite), Banyan VINES, and LAN Manager network operating systems are supported.

• List price: AirLAN/Bridge, \$4,999; AirLAN/Hub, \$4,799; AirLAN/Internal, \$799. Soltek Corp., 6370 Nancy Ridge Dr., San Diego, CA 92121; 619-450-1220; fax, 619-457-2681.

Circle 954 on reader service card

NEW

Capstone Unites 3270 Emulation and PCMCIA

Capstone Technology's new MicroLink Credit Card adapters offer mainframe or midrange network connectivity for a wide variety of PCMCIA-equipped laptop and notebook computers. The 3270 MicroLink Credit Card adapter is fully compatible with any 3270 emulation software that supports IBM or Digital Communications Associates (DCA) register-level compatibility, including products from Attachmate Corp., IBM,

BRIEFS

TOKEN-RING ADAPTERS

Olicom USA is offering new Token-Ring PowerMAC drivers that aim at increasing Token-Ring performance in high-end servers and routers. The ISA/MCA version is \$895, and the EISA version is \$950. ODI, IPX, and Network Driver Interface Specification (NDIS) drivers are shipping with all-new adapters, and current Olicom users may upgrade for free. 241-423-7560.

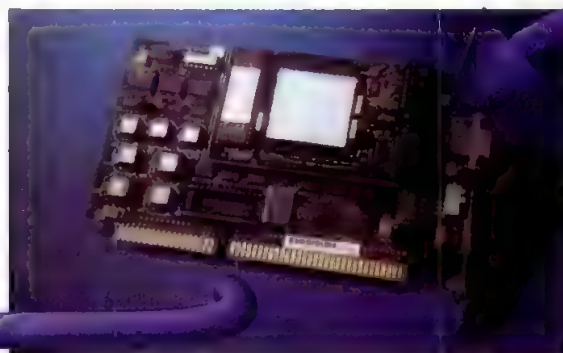
Thomas Conrad reduced the price of its TC4045 16-bit ISA adapter to \$495, down from \$599. Six-pack and fifty-pack bundles have been reduced by \$570 to \$2,850 and \$4,400 to \$21,850 respectively. 800-332-8683.

WIRING HUBS

Ungermann-Bass announced price cuts of up to 43 percent on its ASM1000 FDDI concentrator and its complete line of FDDI adapters. The ASM1000 is available in 4- (\$7,995), 10- (\$17,995), and 16- (\$27,995) port configurations. FDDI adapters for ISA, EISA, and MCA cost \$1,995 and come with drivers for Novell's NetWare, Microsoft LAN Manager, and Unix. 800-777-4526.

SynOptics Communications has introduced an asynchronous transfer mode (ATM) switch, ATM management software, and an ATM SBus adapter card for Sun SPARC/Solaris workstations. The SynOptics LattisCell (\$1,495 to \$1,995 per port) standalone ATM switch features 16 155-Mbps ports and can be managed by the LattisCell Management Application 1.0 (\$3,495). The switch and the software will be available in the third quarter, and the ATM SBus adapter card will be ready to ship by the end of 1993. 408-988-2400.

You can spend more green but you can't get Token Ring any bluer than this.



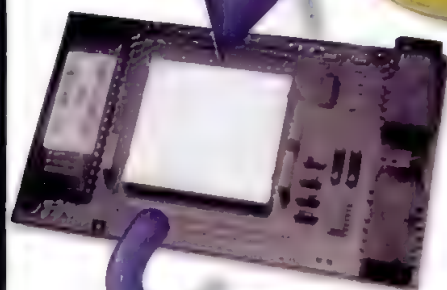
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This is an NDC OpenToken card - one of a complete line of Token Ring adapters with the IBM mini-module. Which is why NDC adapters are absolutely 100% compatible and have a lifetime functionality guarantee.



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If you want to expand an existing IBM Token Ring LAN and would like to do it more economically or if your Token Ring network is based on hardware that's "not-so-compatible" and you're tired of working around the problems, get the security of absolute compatibility by choosing NDC OpenToken adapters. You get exactly the same performance and security from an NDC OpenToken adapter as with an IBM Token Ring card. **Exact-ly!** And they're more affordable! Don't believe it? Try one free for 30 days! If it doesn't live up to your expectations send it back. Call us today for a 30-day free trial.

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and DCA. The 3270 MicroLink Credit Card adapter supports both CUT and DFT emulation modes.

The 5250 MicroLink Credit Card adapter is fully register-compatible with IBM's 5250 Enhanced emulation adapter. Features include display and printer emulation as well as 5150 pass-through for PC Support AS/40. Support for seven concurrent sessions is also available to handle other terminal-emulation software.

MicroLink cards have 128K of flash memory to store future drivers. They also have a 64K data buffer, coax or self-terminating twin-axial "T" media cables, and software diagnostics.

• List price: 3270 MicroLink Credit Card, \$620; 5250 MicroLink Credit Card, \$687. Capstone Technology, 47354 Fremont Blvd., Fremont, CA 94538; 510-438-3500; fax, 510-651-7035.

Circle 955 on reader service card

NEW

FiberNet Ships Low-Cost Ethernet-to-FDDI Bridge

FiberNet's new FR2110 brings new levels of price/performance to the FDDI-to-Ethernet bridge marketplace. The FR2110 is capable of filtering data at 500,000 packets per second and forwarding the Ethernet maximum of 14,800 packets per second, according to FiberNet. It comes standard with one FDDI, one Ethernet, and one RS-232C port and can learn 1,024 active FDDI and 1,024 active Ethernet addresses.

FiberNet offers the unit in two versions: one that supports multimode fiber and one that supports single-mode fiber. Network management is supported through an optional SNMP agent.

• List price: FR2110, \$8,285; FiberNet Research Inc., One Tara Blvd. #405, Nashua, NH 03062; 603-891-2600; fax, 603-891-4242.

Circle 956 on reader service card

NEW

Burr-Brown's Portable, Ruggedized Computers Gain TCP/IP

Now stores and other businesses can easily pass valuable information to Unix hosts, thanks to LANpoint and TIMEpoint. The two diminutive, ruggedized PCs developed by LANpoint Systems, a division of Burr-Brown Corp., now run off-the-shelf software based on TCP/IP, the communications protocol used by Unix systems. Both products can be used to collect bar code, RS-232 serial, and digital I/O data directly on the network. Direct connection for either a thin wire or 10BaseT Ethernet network is available.

LANpoint computers are available in two models: LANpoint, a small (5 by 9 by 1.5 inches) rugged PC with a standard QWERTY keyboard, and TIMEpoint, a time-clock replacement. Both models include two bar code ports, two RS-232 serial connections, two isolated digital inputs and form C relay outputs, external display capabilities, internal 2- by 40-inch display, and a connector for an external floppy disk drive.

• List price: LANpoint and TIMEpoint, \$1,395. Burr-Brown Corp., LANpoint Systems Division, 6550 S. Bay Colony Dr., Tuscon, AZ 85706-7148; 800-328-2526; fax, 602-741-4216.

Circle 957 on reader service card



Burr-Brown's ruggedized PCs allow Unix users to easily collect bar code, serial, and digital I/O data.

BRIEFS

ETHERNET ADAPTERS

Compex Inc.'s new Value Line high-speed, low-cost (\$89 to \$109) Ethernet cards, the ENet-V 16 and ENet-V1 16 TP, feature 16K of on-board RAM and can be configured automatically for either 8- or 16-bit systems. They are compatible with drivers written for Eagle and Western Digital adapters. 717-630-7302.

Ungermann-Bass's new 32-bit EISA Ethernet adapter card is fully software-configurable and also offers bus mastering for maximum performance. The \$759 UB-UTP32A card simplifies network administration with built-in node identification and can be managed using Ungermann-Bass's NetDirector management system. Status LEDs provide diagnostic information about important network parameters such as link status, reversed polarity, and the type of wiring selected. 800-777-4526.

Microaccess Inc. is now shipping its 100-EISA, a \$699 EISA network interface card that provides users with FDDI-like 100-Mbps speed over both shielded or unshielded twisted-pair Ethernet cabling. Microaccess uses an FDDI-type packet with the Ethernet protocol in the design of its product. 408-436-5400.

GATEWAYS

Starnine Technologies Inc. is shipping Mail*Link for Vines/QM. Mail*Link connects the QuickMail and VINES mail networks, replacing a similar product, Banyan's discontinued MacVines gateway for QuickMail. Pricing starts at \$595 for a ten user configuration. The gateway's features include support for multiple file enclosures. 510-649-4949.

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NEW

Alcom's New Fax Server Connects 32 Fax Lines

For companies with heavy inbound and outbound fax traffic, there's now relief. Alcom's LanFax Redirector 2.1-GL (LFR 2.1-GL) quadruples the fax lines normally supported by a single fax server. With more fax lines, you can ship more faxes faster.

There are five ways to route faxes to a user; two are the expensive Direct Inward Dialing (DID) and Alcom's newly developed Non-Standard Format (NSF). NSF routes faxes based on information found in the fax header.

New features also include TIFF support and customized printed confirmation slips.

• List price: *LanFax Redirector 2.1-GL (50-user version)*, \$2,995; *100-user version*, \$4,995; *FaxManager user interface*, \$995 per LAN. Alcom Corp., 1616 N. Shoreline Blvd., Mountain View, CA 94043; 415-694-7000; fax, 800-873-1329.

Circle 958 on reader service card

NEW

CD Net, Version 4.4: CD-ROM Management for NetWare

Using CD-ROM drives to store files has never been easy. That is, until Meridian Data shipped CD Net, Version 4.4 for NetWare. The new software-based management solution is based on the CD Net NetWare Loadable Module (NLM), a server-based application that allows Novell NetWare 3.x and 4.x file servers to support CD-ROMs either as NetWare volumes or as DOS drives. As NetWare volumes, they require no software other than the NetWare Redirector for user access. When they are configured as DOS drives, the enhanced CD Net Redirector minimizes client-workstation memory usage while maintaining 100 percent compatibility with Microsoft CD-ROM Extensions (MSCDEX).

CD Net offers information management tools for both users and administrators, ranging from a selection of optional NetWare security features to optimal CD resource configuration for standalone CD-ROM drives.

• List price: *CD Net, Version 4.4 for NetWare*, \$645 with 10-user license; Meridian Data Inc., 5615 Scotts Valley Dr., Scotts Valley, CA 95066; 800-767-2537, 408-438-3100; fax, 408-438-6816.

Circle 959 on reader service card

NEW

Novell's DataClub Improves Macintosh File-Sharing

With its first release of DataClub, Novell provides network managers with yet another way to integrate Macs into their PC networks. DataClub 3.0 combines the centralized network management of a dedicated server with the convenience and economy of a peer-to-peer network. Best of all, DataClub 3.0 can coexist with NetWare for the Macintosh on a network, letting Macs share information with PCs.

DataClub 3.0's virtual server technology lets users see and access information on any Mac's unused disk space through one central directory without needing to know where the information physically resides.

DOS-based PCs using Farrallon's PhoneNET client software can also access DataClub files, and Novell indicated that it will develop a cross-platform version of DataClub.

• List price: *DataClub 3.0*, \$595. Novell Inc., 122 E. 1700 South, Provo, UT 84606-6194; 800-453-1267; fax, 801-429-5155.

Circle 960 on reader service card

BRIEFS

FAX SERVER

FACSys, Version 3.31, a new fax server, from Optus Software Inc. offers departmental fax distribution and multiple file server licensing. It can now route incoming faxes over any NetWare network to designated workgroups as well as to individuals using the other routing techniques supported by FACSys: optical character recognition (OCR), Direct Inward Dialing (DID), and Dual Tone Multifrequency (DTMF). FACSys 3.31 lists for \$995 per file server. 908-271-9568.

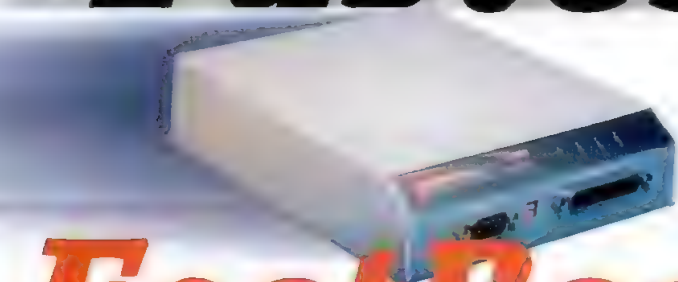
PRINT SERVERS

ASP Computer Products Inc. has upgraded JetLAN 2P to support two printers on a NetWare network simultaneously. The \$695 JetLAN 2P connects to an Ethernet network through an automatically sensed thinnet or 10BaseT connection and is used and administered just like a standard NetWare print server. Additional utilities allow local workstations to use JetLAN print servers even if all of the file servers are down. Versions for NetWare Token-Ring and ARCnet networks are also planned. 408-746-2803.

Castelle released two new LANpress servers for NetWare. LANpress 1 + 1 offers one serial port and one parallel port and lists for \$695 when equipped with both 10BaseT and thinnet connectors and \$595 as a 10BaseT-only version. LANpress 1.1 sports new software that eases installation and configuration with interactive menu-driven programs. The LANpress 1.1 can be speed-optimized for compatibility with older and slower printers without compromising the performance of new, higher-speed printers located on the LAN. 408-496-0474.

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FastPort

Network printing presented major problems
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Time is money and when printers are starved for data by slow connections, it costs time and money. FastPort connected printers whiz along at their highest speed because FastPort's parallel port exceeds any printer's maximum data transfer rate. Unlike other print servers, it transfers large graphics files in seconds, not minutes, saving your valuable time and money.

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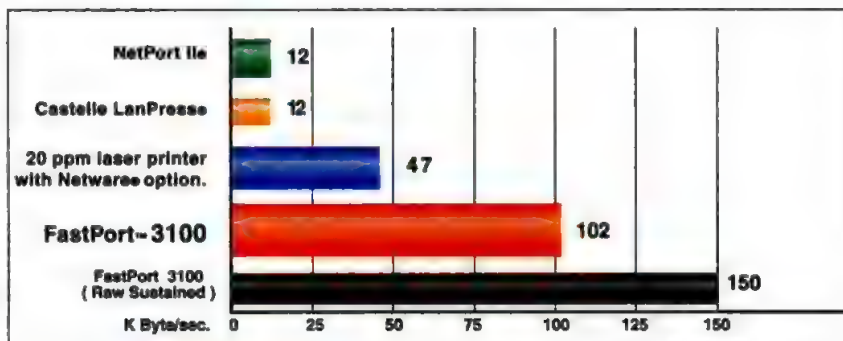
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Introducing the PS/2® Server 195. A server that stares failure in the face. Then succeeds. An enterprise server that delivers rock-solid reliability, around-the-clock availability, remarkable scalability and affordability.

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processors on each of the two standard SCSI channels and memory controller for starters. Up to 28GB of hardfile storage is avail-

able. And since the Server 195 is completely upgradable—to PS/2 Server 295 specs—you can add subsystems to achieve a higher level of fault tolerance when and where it makes sense.

With the Maximum Availability and Support System/2 (MASS/2) option, the Server 195 provides comprehensive local and remote server monitoring, control, tuning and recovery capabilities.



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It even tolerates



MASS/2 works with a battery backed-up Remote Maintenance Processor (RMP)

option that can notify you of errors, failures, corrective action

taken—even provide system access during a power failure. And

you can extend fault tolerance to the entire disk subsystem by adding an Orthogonal RAID-5 Disk Array/2.



The MASS/2 option has a user-friendly GUI that lets you distribute computing power across your organization from a central location.

Server 195/295 Comparison

Feature	Server 195	Server 295 Model 1	Server 295 Model 2
Remote Maintenance Processing and Modem	optional	standard	standard
Processors	486/50 MHz	MP-486/33 & 50 MHz	MP-2 486/50 MHz
Available Slots	8 Micro Channel®	12 Micro Channel	12 Micro Channel
MASS/2	optional	standard	standard

Like all PS/2s, the Server 195 is backed by IBM HelpWare™—a range of service and support so complete, it's hard to find fault with. You get a three-year on-site warranty with four-hour average response time*, around-the-clock set-up, usage and service assistance on IBM hardware and software during warranty,** a 30-day money-back guarantee** and more. For more information or an IBM certified dealer near you, call our Personal Systems HelpCenter™ at 1 800 772-2227 or TDD ASCII 1 800 426-4238. In Canada, call 1 800 465-7999. The new PS/2 Server 195 is so reliable, why would you tolerate anything less?

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IMPROVED

Systems Enhancements Adds SNMP to UPS

Lots of vendors let you gather information from their own uninterruptible power supply (UPS) using SNMP, but few ship SNMP for other vendors' UPSes. Yet that's exactly what Systems Enhancements has done.

PowerMon and SmartMon gather information about a UPS and pass that data to any SNMP-based management console. The simpler product, PowerMon, allows a UPS to notify a network when a manager-specified threshold is exceeded. The more sophisticated application, SmartMon, also allows the network manager to query the UPS.

In addition to these upgrades, Systems Enhancements brings SNMP capabilities to a wide variety of UPS products via its universal hardware agent. The agent plugs into the back of a UPS.

• List price: *PowerMon*, \$199; *SmartMon*, (OEM through UPS/no official list price); *universal hardware agent*, \$699. *Systems Enhancements Corp.*, 221 Chesterfield Industrial Blvd., Chesterfield, MO 63005; 314-532-2855; fax, 314-537-2791.

Circle 961 on reader service card

IMPROVED

3Com Adds New SNA Functionality to NETBuilder

With software enhancements that allow Systems Network Architecture (SNA) traffic to be routed over a wide area network (WAN), 3Com delivers on promises it made last year when it became the first router licensee of IBM's Advanced Peer-to-Peer Networking (APPN) network node technology. NETBuilder 6.0's IP tunneling routes SNA data encapsulated in IP packets over the same WAN link as other Token-Ring, Ethernet, and FDDI traffic. This takes advantage of the superior routing capabilities of IP, preventing disruption of SNA sessions if a network link fails.

To contend with broadcast storms that can be caused by the broadcast-intensive IBM NetBIOS and NetBIOS Extended User Interface (NetBEUI) protocols, NETBuilder offers a new throttling feature that lets users control the rate at which broadcast and multicast traffic is admitted onto the WAN.

Two other new features are class of service and boundary routing. Class of service is a data prioritization feature that ensures delivery of the highest-priority packets before that of other packets. Boundary routing is a system architecture that aids in local router administration at Token-Ring sites.

• List price: *NETBuilder 6.0*, \$750 to \$2,000. *3Com Corp.*, 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052-8145; 800-242-3266, 408-764-5000; fax, 408-764-5001.

Circle 962 on reader service card

NEW

High-Speed Serial Link Without the High Cost

Atlas Computer Equipment has announced a new high-speed, full-duplex, serial interface card called the SSL1A. Taking advantage of the company's new Speedy Serial Link (SSL) technology, this 16-bit ISA-bus card provides data-transfer speeds of up to 100 Mbps at distances of up to 200 feet using two pairs of unshielded twisted-pair cable terminated with an RJ-45 connector.

The SSL1A can transfer data between the buses of two computers in half the time it takes to perform an I/O write cycle on the AT bus, effectively connecting the expansion buses of the two computers together. Atlas is developing cards for both Extended Industry Standard Architecture (EISA) and MCA buses.

To enable the SSL interface to be used in a star-type network, Atlas is developing

BRIEFS

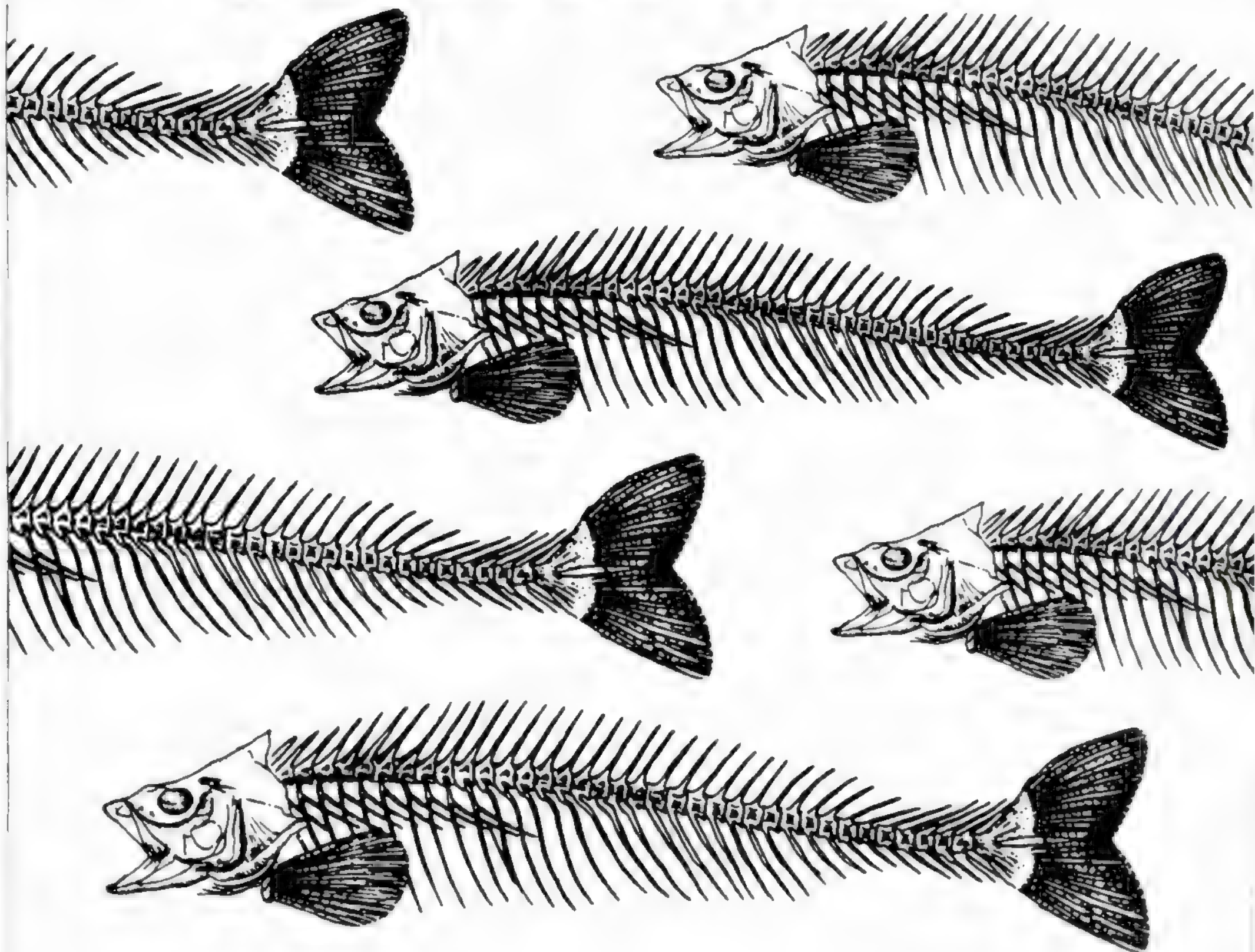
ROUTERS

Proteon Inc. released the new Corporate Network Exchange (CNX) 600, which features the Proteon Internetworking Traffic Management (PITM) technology that guarantees availability for mission-critical SNA traffic in networks mixing both IBM and non-IBM traffic. PITM can also ensure that network management bandwidth will be available during times when it's most needed. The RISC-based CNX600 can support up to five FDDI networks, 20 4/16 Token-Ring or Ethernet LANs, and 20 WANs and supports all major industry standard protocols. 508-898-2800.

Novell added source-route bridging to its low-cost software-based NetWare Multiprotocol Router. The new Version 2.1, which lists for \$995, is compatible with existing IBM source-routing bridges. It can run on any 386/486-based PC with 8MB RAM and 40MB of hard disk space and Token-Ring cards from Madge, 3Com, IBM, and Novell, or on an existing NetWare file server. The router is managed using standard NetWare utilities such as RCONSOLE and MONITOR, or from any SNMP console. 800-453-1267.

Cisco released a low-cost FDDI router with its \$12,900 Cisco 4000 FDDI router. The three-slot unit holds one of Cisco's new FDDI Network Processor Modules, plus any combination of Ethernet, Token-Ring, and serial interfaces and supports more than 15 communication protocols. The FDDI Network Processor Module supports a full set of FDDI fault-tolerant and redundancy features, including dual-attached station for continuous operation if a station or cable plant fails. 415-326-1941.

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the Hydra12 Network Switch, which is due for release in the fourth quarter of 1993. It will sport a 1.6 Gbps backplane and slots for 12 SSL interface modules.

• List price: *SSL1A*, \$495. Atlas Computer Equipment, P.O. Box 91929, Santa Barbara, CA 93190; 800-224-1223, 805-962-5979; fax, 805-965-4745.

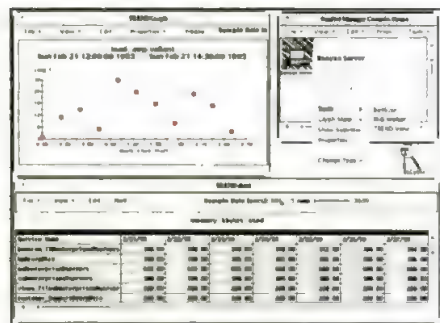
Circle 963 on reader service card

NEW

TCE Integrates VINES, NetWare, and SunNet Manager

The TCE Technology Group has integrated BanScan II, its network management product for PC-based LANs, with Desk Talk System's TRENDsystem, a network management system based on SunConnect SunNet Manager. This union lets managers oversee all of the LANs on their network from a single SunNet console.

BanScan II provides a single Microsoft Windows console for VINES, NetWare, and SCO Unix, and includes individual server statistics and alarm notification, real-time and historical trending, and packet timing and tracing facilities.



TCE's BanScan II allows for enterprise-wide monitoring of Banyan, Novell, and Unix networks.

Technology Group, 1977 O'Toole Ave., Suite B202, San Jose, CA 95131; 800-424-2388, 408-321-7600; fax, 408-321-7601.

Circle 964 on reader service card

IMPROVED

Digital Equipment Adds Macintosh Support to Pathworks

Digital Equipment Corp. released new versions of its Pathworks client and server software for Macintoshes that simplifies network configuration and management and makes access to network services more efficient.

Pathworks, Version 1.2 for Open VMS (Macintosh) server software provides file, print, and mail services for Macintosh clients attached to Digital VAX and Alpha servers. Pathworks, Version 1.2 for Macintosh clients runs on Macintoshes and supports LocalTalk, Ethernet, and Token-Ring connections.

The enhanced server software allows multiple logical AppleTalk zones to exist across multiple servers and can limit the number of connections to a specific VAXshare volume. It also supports AppleTalk tunneling, allowing Macintosh users to connect to remote AppleTalk LANs over the DECnet/OSI transport for Open VMS systems.

The new Macintosh client software includes an application called Pathworks Listener, which alerts users of new messages. Pathworks for Macintosh runs on all the new Macintosh hardware and on the latest Mac OS, System 7.1.

• List price: *Pathworks, Version 1.2 for Open VMS*, \$308. Digital Equipment Corp., 146 Main St., Maynard, MA 01754-2571; 800-332-1232; fax, 508-493-8780.

Circle 965 on reader service card

BRIEFS

IBM has announced a low-end 6611 Network Processor router that lets existing SNA or TCP/IP applications work over either SNA or TCP/IP transports. The 6611 Model 120 lists for \$6,995 and supports one local port that can be configured for Token-Ring or Ethernet. It can also support two V.36/36 or EIA 422/449 interfaces, one X.25, or four SDLC interfaces. It runs the same software as the larger model, 6611s, and provides the same multiprotocol routing, source route bridging, transparent bridging, and data link switching of SNA and NetBIOS traffic. 914-765-1900.

NETWORK MANAGEMENT

Accugraph Corp. and **Networkx Inc.** plan to integrate their configuration management and trouble ticketing applications. Accugraph's \$8,000 Mountain View product provides physical network management, computer asset management, cable plant management, and network connectivity analysis. Networkx's Paradigm, at \$10,500, integrates trouble ticketing with inventory and provides analysis and tracking capabilities. The new product will automatically recognize a problem and generate a trouble ticket and alert the appropriate person. Accugraph, 800-678-1062; Networkx, 206-646-1870.

Axon Networks Inc. has announced integrated distributed LAN management for Ethernet and Token-Ring networks. LANServant Probe is available for both topologies as an application on Sun's SunNet Manager or on HP's OpenView and monitors any RMON-compliant devices. It drives both the Token-Ring and Ethernet probe remotely, including administration, setup of the probe, and delivery of upgrades and additional modules. 617-923-2205.



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STARTER KITS



Starter kits that provide everything required to connect 2 computers using Ethernet Thin Coax Cable.

2-Station Network Lite \$349

- 2- Novell Network Lite 1.1 Software
- 2- 16 Bit Alta Combo Adapters
- 1- 25' Length RG58A/U Coax
- 2- 52 Ohm Terminators

5-Station Starter Kit with Novell 2.2 \$1149

- 1- Novell Network 2.2.5 User
- 1- 16 Bit Alta Combo Adapters
- 1- Cable Crimping Tool
- 10- BNC Connectors
- 2- 52ohm Terminators
- 1- 500' Spool RG58A/U Thin Coax

5-Station Starter Kit with Novell 3.11 \$1249

- 1- Novell Network 3.11.5 User
- 1- 16 Bit Alta Combo Adapters
- 1- Cable Crimping Tool
- 10- BNC Connectors
- 2- 52 Ohm Terminators
- 1- 500' Spool RG58A/U Thin Coax

5 to 10 Station 10BaseT Starter Kit With Novell 3.11 Software \$2495

- 1- Novell 3.11.10 User Software
- 5- Alta 10BaseT Adapters
- 1- TTC 12 Port 10BaseT Wiring Hub
- 1- 1000' Spool 8 Conductor TP Wiring
- 1- RJ45 Crimping Tool
- 20- RJ45 Connectors

NOVELL

4-Station 10BaseT Starter Kit Featuring Novell or Artisoft Software \$849

- 4- Network Lite 1.1 or Artisoft A1.1
- 4- 16 Bit Alta 10 BaseT Adapters
- 1- Anthem 4 Port External Hublet
- 1- 250' Length 8C UTP Wiring
- 1- RJ45 Crimping Tool
- 10- RJ45 Connectors

Portable 2-Station Starter Kit \$449

- No Slot External LAN Adapters Artisoft or Novell Software
- 2- Network Lite 1.1 or Artisoft A1.1
- 2- PE-300B Pocket Ethernet Adapters
- 1- 25' Length RG58A/U Coax
- 2- 52 Ohm Terminators

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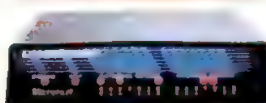
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"Are you ready for this? I stay at work late the other day to change the network interface card on our file server. I want to get it done before morning so no one is inconvenienced. Basically, it's a piece of cake. Until I try to bring the network back up and the server won't attach itself to it. So now 87 PCs are down. Now if I don't get this fixed, these folks will show up for work but won't be able to. So either I solve the problem now or bear the wrath of some important people around here tomorrow.

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Unix and NT: Making the Right Choice

Historians report that just after the attack on Pearl Harbor, Admiral Yamamoto reflected that he might have awakened a sleeping giant. The coming of Microsoft's Windows NT 32-bit operating systems seems to have ended the slumber of the biggest players on the Unix front.

HP, IBM, The Santa Cruz Operation, SunSoft, Univel, and Unix System Laboratories have now joined forces to promote standards for a Common Open Software Environment (COSE) for Unix.

While the initial focus of COSE has been on a standard GUI interface, the ultimate goal is to end the "Kernel War" that still fragments the Unix industry. This lack of standardization scared both developers and buyers away from making a big investment in Unix. With COSE, the group is trying to build trust and enthusiasm for the only operating system it believes can slow Microsoft's NT wave.

Unix holds the high ground in RISC-based graphics workstations. Its multiuser capabilities make it the top choice for low cost-per-seat applications such as accounting systems. And the library of Unix business applications is huge as well. SunSoft just announced a plan to run Windows apps under Unix. The advance agents of Unix-ism are in place. Corporate network managers have adopted Unix as the basis of network management systems and sophisticated backup systems. TCP/IP reigns supreme across corporate networks.

The sharpest point of the Unix spear is SunSoft's Solaris, the 32-bit version of its Solaris operating system for Intel-style x86 microprocessors. Solaris offers a proven global naming service, advanced network security, DES data encryption, symmetrical multiprocessing, and other "right stuff" for enterprise-wide computing. With Network File System (NFS), Solaris does both peer-to-peer and server-based networking. SunConnect, a sister company, offers a variety of products that bring the DOS/Windows PC and NetWare into Solaris.

The struggle for the corporate desktop pits two well-matched contenders. NT's marketers are still groping for the right pitch. Unix has a long lead in enterprise system but fragmentation has been a huge obstacle, raising COSE's odds in the upcoming struggle. Both sides will find that no marketing plan survives initial contact with reality. But unlike other conflicts, this tussle of the giants will benefit the populace.

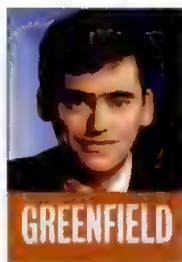


The sharpest point of the Unix spear is SunSoft's Solaris for Intel-style x86 microprocessors.

C'mon, Frank. You don't really expect us to buy that hogwash. Let's look at the plain truth: Novell is worried about NT—specifically, NT Advanced Server. That's why it's moved to join up with Unix. That's why it's developed a redirector for NT. Even Novell realizes that it needs to embrace NT. It knows that NT Advanced Server will penetrate the corporate environment.

And for good reason. NT promises to offer a multithreaded, operating system with 32-bit addressing, C2 security, portability across different processors, and probably best of all, support for DOS and Windows applications. NT Advanced Server will support multiple clients, offer desktop TCP/IP, and multiserver/multidomain management.

With those credentials, Novell is even more worried about NT as a file server.



The nirvana of a Unix standard will be about as permanent as the long-term success of Japan's attack on Pearl Harbor.

That's the real reason that Novell rushed to integrate Unix. It needs to provide a platform to its customers that is robust enough to develop applications. Novell wants us to think that by collaborating with the Unix vendors, it will be able to create a single kernel that will function across multiple platforms.

Be real. How many companies actually run Unix? Sure, Unix dominates in the engineering, scientific, and brokerage houses. But outside that enclave, Unix's penetration is nil. Mainframes (and that still means IBM) are still the backbone of most businesses—not Unix.

What's more, when was the last time a vendor consortium actually stuck to its specifications? As vendors look to exploit their products, they will have to adapt their operating systems. Over time, that will mean new wrinkles in the OS. The nirvana of a unified Unix standard will be about as permanent as the long-term success of Japan's attack on Pearl Harbor.

Best of all, NT will run on the desktop and on the server, giving network managers a single environment to manage. You won't have to learn Unix commands and NetWare calls.

SunSoft recognizes the importance of a single operating environment. That's why it is coming out with the Intel version. But I ask you: Which would you rather run—an operating system built to run Windows and DOS applications or an operating system with Windows and DOS support added on? The answer is clear: Windows NT and NT Advanced Server. I say, let the giants keep slumbering.

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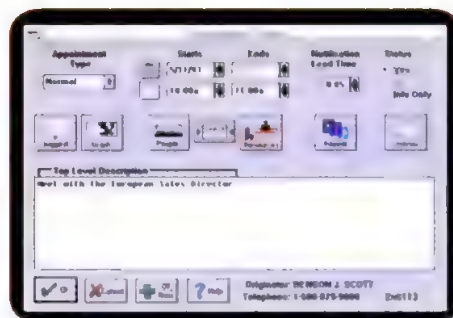
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Moving PRINT.COM

Automating Print Echo

BY NEIL J. RUBENKING

MOVING PRINT.COM TO UPPER MEMORY

I use several programs that look for the DOS PRINT command and will refuse to load if they fail to find it. Simply running PRINT at startup solves the problem easily, but also consumes 5.6K of precious conventional memory (under DOS 5.0)—a waste I can't afford if I'm not using applications that rely on PRINT. Luckily, DOS 5.0's LOADHIGH allows me to make PRINT memory-resident at bootup yet keep it out of lower RAM. This instruction, added to my AUTO-EXEC.BAT, does the trick:

```
LOADHIGH C:\DOS\PRINT /D:PRN
```

The /D:PRN qualifier directs output to the PRN device (LPT1, by default). LOADHIGH delivers a real bonus to 386/486 users who have UMBs into which they can load device drivers. It solved my problem and left me more than 621K of conventional memory.

*Kevin E. Matthews
Rockford, Michigan*

► **PC MAGAZINE:** So many multitaskers exist these days (Windows, DESQview and the DOS Shell, to name a few) that demand has declined for PRINT.COM's ability to split the processor's attention between printing and other activities. There is, however, a defined interface by which other programs can directly instruct PRINT to queue files for printing. Programs using the interface naturally insist that PRINT be present in memory. Preloading PRINT in upper memory enables these applications to function properly while not reducing the amount of conventional memory.

PRINT is a RAM-resident print spooler. Its purpose, though, is not to

speed up printing—in truth, it may actually slow the process just slightly. Rather, PRINT is meant to let you get back to work quickly after you send a job to a printer. (Without it—or a similar utility—DOS programs remain inaccessible until the job completes.) PRINT accepts data that is directed to the printer as fast as your program can send it and passes the information along to the printer as fast as that device will accept it. If you're unable to continue work until a print job finishes, you should consider loading PRINT.COM.

PRINT.COM also holds the distinction of being the first widely used RAM-resident program. Many a canny programmer disassembled the original to learn just what undocumented function calls were required to safely make a program RAM-resident!

AUTOMATING PRINT ECHO

Ctrl-P can be used to toggle the echoing of text displayed on the screen to the printer. In DOS 3.1, the flag that is toggled is located at offset 02AC in the same segment as INT 20. I created the DEBUG script PRNECHO.SCR (Figure 1) to produce two programs: PRNECHO.COM to set that flag, and PRNXCCHO.COM to clear it.

*Walter E. Roop
North Hollywood, California*

► **PC MAGAZINE:** With a little tinkering, I was able to determine that in DOS 5.0 the offset for the print-echo flag is 2FE. I modified the DEBUG script to use this value instead. Of course, if you're using DOS 3.1, you can simply change all occurrences of 2FE back to 2AC. To create the programs, enter the command

```
DEBUG < PRNECHO.SCR > PRNECHO.LOG
```

Scan the log file. If it contains any ^ Error lines, correct the corresponding line in the script and repeat the process.

I added a few lines to PRNECHO.SCR to make it generate one more program, ISPRNECH.COM. This program checks the print-echo byte, returning an exit code of 0 if print echo is active, 1 if not. If ISPRNECH.COM returns any other exit code, the DOS version is not compatible with PRNECHO.COM. The batch file PECHO.BAT in Figure 2 demonstrates a safe way to use the printer echo control programs.

Don't be upset if PECHO.BAT reports an incompatible DOS version. If you can find the print-echo flag on your system, you can make the PRNECHO.SCR programs work. Fire up DEBUG and give the command D 0:82 L 2. The result will be two numbers: for example, 23 01. Reverse the order of the two pairs of numbers to form the segment address of INT 20; in this case, 0123. Then enter the command D ####:2A0, where #### represents the segment address number. That displays 128 bytes of memory in the general area of the print-echo flag. Now press Ctrl-P and give the command again. Scan the blocks of bytes dumped by the two commands, looking for one that changed from 00 to FF when you pressed Ctrl-P. If you find such a byte, you should

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PRNECHO.SCR

Complete Listing

```

N PRNECHO.COM
A100
PUSH DS
PUSH AX
XOR AX,AX
MOV DS,AX      ; DS contains 0
MOV AX,[0082]
MOV DS,AX      ; DS contains segment of INT 20h
MOV AL,FF      ; FF = printer echo ON
MOV [02FE],AL  ; set value of print-echo flag
POP AX
POP DS
INT 20

RCX
14
W
N PRNECHO.COM
E 10C 00
W

N ISPRNECH.COM
A 10B
MOV AL,[02FE] ; move print-echo flag into AL
ADD AL,1      ; add 1, so ON=1, OFF=0
MOV AH,4C     ; select terminate w/ return code function
INT 21

RCX
1C
W
Q

```



Figure 1: This DEBUG script generates three small utilities that set, clear, and test the print-echo flag.

PECHO.BAT

Complete Listing

```

@ECHO OFF
REM PECHO.BAT - set printer echo ON (+) or OFF (-)
ISPRNECH
IF ERRORLEVEL 2 GOTO Incompatible
FOR %v IN (+, -) DO IF '%1'=='%v' GOTO SetIt
ECHO Syntax: PECHO + or PECHO -
GOTO End
:=== SetIt =====
IF '%1'=='-' GOTO SetOff
PRNECHO
GOTO End
:=== SetOff =====
PRNKECHO
GOTO End
:=== Incompatible ===
ECHO Sorry, this DOS version is not compatible with PRNECHO.COM.
:=== End =====

```



Figure 2: This batch file uses all three print-echo programs created by the DEBUG script in Figure 1 to safely turn printer echo on and off.

substitute its offset for 2FE in PRNECHO.SCR and run the script through DEBUG again.

This is not a perfect solution. As you've seen, it's DOS-version dependent. It also fails under certain multitasking or menuing systems, such as DESQview, that trap INT 20. But it works!

You can download all the files men-

tioned from the Utilities/Tips Forum on PC MagNet, archived as PECHO.ZIP.

CUSTOMIZING THE SHELL'S SYSTEM PROMPT

After reading the User-to-User tip that showed how to change the DOS prompt while in a DOS session under Windows, I realized how useful it would be to do this with the DOS 5.0 Shell.

While in the Shell's program list, move to the Command Prompt item to highlight it (don't hit Enter to actually activate it) and select Properties from the File menu to bring up a dialog box. On the Commands line of the dialog box, add a PROMPT command in front of the word COMMAND. Set the prompt to be different from your normal prompt, and make sure you separate it from the word COMMAND by space-semicolon-space, as the syntax requires. My Commands line now looks like

```
PROMPT (Shell)$p$g ; COMMAND
```

Press Enter or click OK to close the dialog box and return to the DOS Shell menu. Your new prompt serves as a handy reminder that the Shell is running, making it far less likely that you'll accidentally start it multiple times, inadvertently wasting a large amount of memory.

James Waddell
Waseca, Minnesota

► **PC MAGAZINE:** It's certainly useful to have a visual reminder that your DOS session is actually running under the DOS Shell, since executing a second instance of DOSSHELL.EXE wastes a good deal of memory. Note that you must have a space between the end of the PROMPT command and the semicolon, which isn't removed and thus becomes part of your prompt. No amount of backspacing will eliminate the gap between the cursor and the > symbol!

For a more eye-catching reminder of current status, try this at the Commands line in the File Properties dialog box:

```
PROMPT Type EXIT to return to
MS-DOS Shell$_$p$g ; COMMAND
```

Also note that you can expand the amount of environment space in a DOS session under the DOS Shell by adding a /E: switch at the end of the line. For example, /E:512 after the word COMMAND raises the available environment space from the default 256 bytes to 512. □

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How DOS Programs Can Use Over 1MB of RAM

BY JEFF PROSISE

W

hen engineers at IBM designed the IBM PC in late 1980, few of them could have imagined that 1MB of RAM would soon seem like so little. 16K was a lot of RAM in those days, and personal computers with 64K of RAM were a luxury that few could afford.

Today it's hard to buy a PC with as little as 1MB of RAM. Most 386s come with at least 2MB, while a typical 486 comes with 4MB or more. Sadly, the majority of this RAM goes unused on most PCs unless they happen to be outfitted with Microsoft Windows, DESQview 386, or a similar protected-mode supervisory program, because few DOS applications are written to use more than 640K. Fortunately, this needn't be the case.

DOS is a real-mode operating system. That used to mean that the microprocessor was limited to addressing 1MB of RAM. However, today there are plenty of ways for programmers writing DOS applications to break the 1MB barrier without forsaking DOS. Here, in terms that nonprogrammers can understand, I'll explain how programmers use the Expanded Memory Specification (EMS), the Extended Memory Specification (XMS), DOS extenders, the LOADALL instruction, and increased segment sizes to break the 1MB limit.

EXPANDED MEMORY SPECIFICATION First and foremost among methods for circumventing the 1MB cap on real-mode memory is the Expanded Memory Specification. The first version of the EMS to gain wide acclaim, Version 3.2, was tendered by Lotus, Intel, and Microsoft in September 1985 (3.2 was actually the second version of the EMS; the first, released earlier in 1985, was, for reasons unex-

plained, named EMS 3.0). Version 4.0, the version most widely used today, followed in 1987.

The EMS describes the functional interface for a *bank-switched* memory scheme. EMS bank-switching works by reserving a range of memory addresses (usually 64K) and swapping blocks of EMS memory in and out of this address space. In the EMS world, the blocks are usually 16K in length and are called *pages*.

Figure 1 shows how EMS works. The rectangle on the left represents the 1MB of address space that the CPU can access directly. Conventional memory extends

*Using methods such as the
Expanded Memory
Specification, Extended
Memory Specification, and
DOS extenders, real-mode
DOS programs can access
up to 4GB of RAM.*

from 0K to 640K, and upper memory extends from 640K to 1MB. The rectangle on the right represents 2MB of expanded memory divided into 128 evenly spaced 16K pages. The key is the 64K space set aside in upper memory to serve as the EMS page frame. The page frame contains room for four 16K EMS pages. By placing calls to a driver called an *expanded memory manager* (EMM), an application program can map any arbitrary page of expanded memory to any of the four pages in the page frame. Expanded memory that is mapped to the page frame

can be read and written just as if it were normal memory. By swapping EMS pages in and out of the page frame, a program can access every page of expanded memory it was allocated. Another way of looking at it is that the page frame serves as a window into expanded memory. You can't access all the memory at once, but you can access it all in turn by moving pages in and out of the window.

An important point to note is that a program must be specially written to take advantage of expanded memory. It's up to the program to allocate expanded memory from the EMM (using an entirely different set of function calls from the ones that allocate DOS memory), to map pages of expanded memory to and from the page frame, and to copy data to and from those pages. That's why not all programs can use expanded memory.

Microsoft chairman Bill Gates once called the EMS a kludge. If you're thinking in terms of protected-mode memory, EMS is a kludge. But it's a workable one at that, and it's so easy to write to that it's a wonder more programs don't use it. Expanded memory can be added to any PC, even old 8086- and 8088-based machines. Although expanded memory boards aren't all that common anymore, expanded memory is available to almost everyone these days, because DOS 5.0 and 6.0 come with a driver (EMM386.EXE) that, if asked, converts extended memory—ubiquitous on 386 and 486 PCs—to EMS 4.0 expanded memory. Significantly, DOS 6.0's EMM386.EXE driver allocates EMS and XMS memory from a shared pool, so you don't have to decide ahead of time whether to configure the extended memory in your system as EMS or XMS memory; EMM386.EXE will dish it out as EMS memory to one program and as XMS memory to the next.

EXTENDED MEMORY SPECIFICATION

While expanded memory may not be all that common anymore, extended memory is. Extended memory is all the RAM above 1MB on 286, 386, and 486 PCs. On the surface, an application program that wants to use extended memory for data storage must go to great lengths to do so. First it has to switch to protected mode. Then it does whatever it needs to with the data in extended memory, perhaps copying it to conventional memory where it can be manipulated more easily. Then it must switch back to real mode. It doesn't sound too hard, but in practice it involves a lot of hard work and requires a thorough understanding of the CPU's operation. To make matters worse, DOS doesn't manage extended memory as it does conventional memory, so it's difficult for a program to tell when the extended memory it desires is being used by another program.

Enter the Extended Memory Specification, the product of a collaborative effort between Microsoft, Intel, Lotus, and AST Research. Introduced in August 1988, the XMS defines a software interface to extended memory. Programs that seek to use extended memory for data storage may do so by invoking the services of an extended memory manager (XMM). The XMM takes care of the nuances associated with switching to protected mode and back; to the application program, all that's required to copy data to or from extended memory is a simple function call or two. Some XMM implementations don't even bother to switch to protected mode. Instead they exploit hidden features of the CPU's design (features such as the undocumented LOADALL instruction, which was discussed in the June 16, 1992, Tutor column) that permit the CPU to reach into extended memory from real mode. The bottom line? On a PC with an XMM such as HIMEM.SYS installed, it is simple—almost trivial—for programmers to write applications that store information in extended memory. And since the XMM keeps track of who owns what in extended memory, programs need not fear overwriting blocks of memory allocated to other application programs.

The XMS does more than manage extended memory. It also provides a device-

independent means for programs to access the 65,520 bytes of extended memory called the HMA (high memory area). The HMA is special because it, unlike the rest of extended memory, is easily accessed from real mode using standard segment:offset addressing conventions once the microprocessor's A20 address line is enabled. The XMS provides convenient functions for programs to enable and disable the A20 address line. The XMS also defines a software interface for programs to allocate

and deallocate upper memory blocks created by 386 memory managers such as EMM386.EXE.

Extended memory placed under the control of an XMM is often referred to as *XMS memory*. Like EMS memory, XMS memory isn't doled out to programs automatically; to use it, a program must want to use it and then take special steps to do so. Therefore not all programs use XMS memory. But the number of programs that do is increasing every day.

DOS EXTENDERS DOS extenders are products that permit developers to transform real-mode application programs into full-fledged protected-mode application programs that enjoy access to extended memory. Examples of applications built with DOS extenders include AutoCAD, Releases 11 and 12, Mathematica, and Lotus 1-2-3, Release 3.x. To use these programs, all you have to do is load them up on a 386 or 486 with gobs of RAM, and then let them go. The programs do the rest.

More specifically, the DOS extenders do the rest. When a DOS-extended program is started, the DOS extender, which is bound into the program, takes control and switches the CPU to protected mode. Then it loads the application program

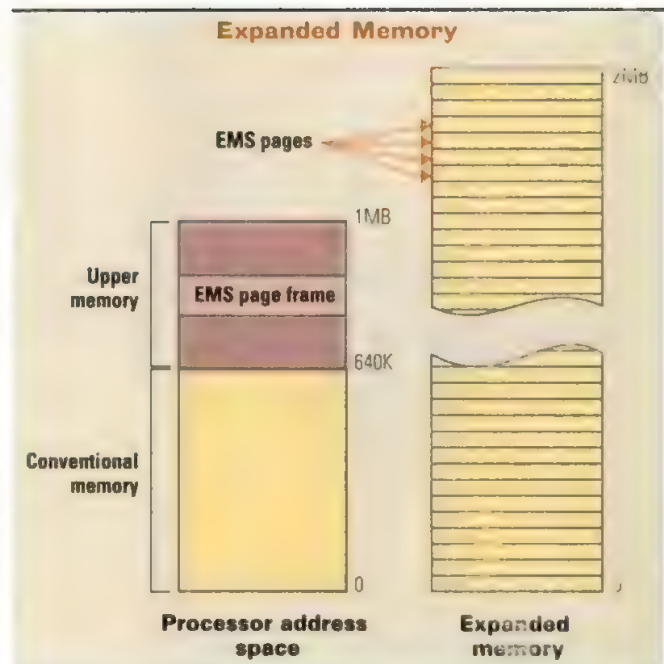


Figure 1: To access data in expanded memory, a program places a call to the expanded memory manager to swap 16K pages of EMS memory (shown at right) into the page frame in upper memory (left).

that it was bound to. When the program places calls to real-mode DOS and BIOS services, the DOS extender either handles those calls itself (in protected mode) or temporarily switches back to real mode, allows DOS or the BIOS to process the service request, and then switches once more to protected mode. This simple description belies the amount of work that must go on behind the scenes to accomplish this little feat of magic, but the beauty of it is that the programmer needn't be concerned with any of it. The programmer can write to an application program interface he's familiar with (the DOS API), abide by a few additional rules imposed by protected-mode operation, and lo and behold, an application that's not constrained by the 1MB barrier is born.

So why don't more programs use DOS extenders? That's a good question. One reason for this could be that many programmers perceive DOS extenders as complex pieces of software that have a steep learning curve, so they put off using them. This is too bad, since an experienced programmer, armed with the proper software tools, can be writing DOS-extended applications in a matter of weeks—maybe even days.

Another reason that more programs don't use DOS extenders is that at one time, before Phar Lap Software and Quarterdeck published the VCPI (Virtual Control Program Interface) specification, DOS-extended applications would not run if there was a 386 memory

*Using DPMI, it's possible
to write protected-mode
programs that behave as
DOS programs; the
difference is that they have
access to all RAM, not just
the first 1MB.*

manager such as QEMM-386 active in the system. Conflicts occurred because both programs (the DOS extender and the memory manager) performed processor mode switches and tried to claim all the extended memory in the system. VCPI resolved those conflicts by defining a communication protocol allowing the DOS extender to borrow RAM from the memory manager and to use services built into the memory manager to switch processor modes. DOS 6.0's EMM-386.EXE fully supports VCPI and therefore supports DOS-extended programs; popular third-party memory managers such as QEMM-386 and 386MAX also support VCPI.

The DOS Protected-Mode Interface (DPMI) has succeeded VCPI as the specification of choice to use when developing standalone protected-mode applications. DPMI defines a subset of DOS and BIOS function calls that may be used by protected-mode DOS programs, and it offers additional functions that DOS lacks for performing tasks such as allocating protected-mode memory, modifying descriptors (values used to translate virtual addresses to physical addresses in protected mode), and making calls to real-mode device drivers. Using DPMI, it is possible to write protected-mode programs that behave in most respects as if they were DOS programs; the differ-

ence is that they have access to all the RAM in the system, not just the first 1MB. Writing to the DPMI is a complicated process, but DOS extenders handle most of the details for you. 386MAX and Windows (and QEMM-386, with the addition of a separate software package called DPMI Host) support this spec.

However, the real reason DOS extenders aren't used more is that developers consider DOS a dying platform. And the fact that user demand for Windows and OS/2 applications is far greater than user demand for DOS programs supports this view. So, rather than pour their resources into writing protected-mode DOS applications, they write applications for modern operating systems such as Windows, Windows NT, and OS/2, which by nature run in protected mode and therefore are not constrained by the limits of real-mode memory.

ACCESSING 4GB FROM REAL MODE Earlier I mentioned the undocumented LOADALL instruction, which provides a back-door mechanism for programmers to access the entire protected-mode address space without leaving real mode. LOADALL loads all the CPU's registers, including the descriptor cache registers used to form higher-than-1MB addresses in protected mode, from a table in low memory. By loading the descriptor cache registers with the appropriate values with LOADALL and then using the 32-bit index registers found on the 386 and 486 to specify offset addresses, a program can access any part of memory from real mode. The LOADALL instruction was used in DOS as early as Version 3.3 and was also used in the 286 versions of OS/2.

Recently, another method of accessing 4GB (or 4,000MB) of memory (the physical addressing limits of the 386 and 486) was brought to my attention by a reader on PC MagNet. Here's how it works:

In protected mode, the size and location of a segment of memory is defined by base address and limit fields in the segment descriptor. In real mode, the base address of the segment is derived directly from the value in the segment register, and it too has a limit. When a 386 or 486 CPU is powered up in real mode, the segment limit is set to 64K so that the seg-

ment registers will work in real mode just like segment registers on an 8086. If we could somehow increase that limit, then we could access up to 4GB of RAM in real mode by using 32-bit registers to specify offsets from the base of the segment.

As you might have guessed, there is a way to change the limit. If you switch to protected mode, increase the limit, and switch back to real mode, the new limit stays put. For this reason, Intel recommends that programmers reset the segment registers to descriptors that have a 64K limit.

The mechanics of switching to protected mode, increasing the segment sizes associated with one or more segment registers, and switching back to real mode are not prohibitively difficult. If you'd like to see them implemented in code, read Chapter 18 of Al Williams's excellent book, *DOS 5: A Developer's Guide* (1991, M&T Publishing). In it, Williams presents the C and assembly language source codes for a program that increases the real-mode segment limits.

The downfall of these last two methods for reaching into extended memory from real mode is that they only concern the mechanics of accessing the memory; they do not take into account memory management issues such as allocating and deallocating blocks of memory in a cooperative manner.

ALL IN ALL... The problem with all the memory standards discussed here is that none provides seamless access to more than 1MB of RAM. If access were seamless, a program would be able to allocate the memory and then use it with standard DOS API functions. Instead a program has to go out of its way to access extended or expanded memory. That's where operating environments such as Windows and OS/2 are superior: Their free memory pools include all the memory in the system, not just RAM below 1MB.

DOS is not the operating system that we'll want to be using 10 years from now. But don't buy into the notion that DOS programs can't possibly access more than 640K of memory. They can, and in the opinion of most DOS users, it's high time we saw more DOS applications that take advantage of EMS, XMS, and other memory-extending techniques. □

Lossless Compression: How It Works

BY BARRY SIMON

File compression techniques have been used in utilities such as PKZIP for years. They've also been commonly employed in tape backup systems and, more recently, utilities such as Stacker have made it possible to compress an entire hard disk and perform decompression on the fly.

How do such products accomplish their magic? In this first of a two-part Lab Notes, I'll discuss the bases of the compression systems such as these. In the next issue I'll address the compression methods used to store video and sound information. This division corresponds to the two broad categories into which compression techniques fall: *lossless* and *lossy*.

LOSSLESS VS. LOSSY A lossless system is one that can produce an exact reconstruction of the original file upon decompression. A lossy system—where the compression factor is generally higher—restores only a close approximation of the original.

The appropriate method depends on the type of file you want to compress. A few changed bytes in an executable program will likely cause a crash. If a spreadsheet file is altered by a few bytes, the *best* result you can hope for is that the program will reject the file as corrupt; in the worst-case scenario, the data itself would be changed. And of course it would hardly do if, by compressing and decompressing a memo, you changed the spelling of your boss's name!

On the other hand, given a 24-bit true-color file, a few changed pixels wouldn't make a noticeable difference. A digital sound file that loses the extreme high frequencies (those above 20,000 Hz) will sound the same to all but your dog. As a rule, files that require lossless compression

are composed of *entered data*, while files that permit the use of lossy methods are made up of *sampled data*.

This Lab Notes will provide an overview of lossless compression. (For a detailed explanation of how the compression utility PKZIP works, see the May 25, 1993, Tutor column "Understanding Data Compression" on this topic.) Next time I'll talk about lossy compression methods, and will also describe some of the third-party libraries available to programmers who want to implement compression in their applications.

YOU CAN'T COMPRESS EVERYTHING Not all files can be compressed. Moreover, any lossless algorithm that can decrease the size of some files must *increase* the

size of other files. These two basic principles form a good starting point from which to discuss compression.

noted, cannot contain the information necessary for decompression. Also, a 0-byte file already represents itself. For lossless compression, the 0-byte file can't represent both the uncompressed 0-byte file and a compressed 1-byte file. If there isn't a unique compressed file for each original file, then the original can't be restored through decompression. So 1-byte files can't be compressed, either.

Suppose we expand the scope of our putative compression algorithm to encompass all the theoretically possible files of 2 bytes or less. If each 1-byte file (and the 0-byte file) must be allowed to retain their size, there aren't any smaller files available into which we could map a 2-byte file. As we consider larger and larger files, the problem remains.

Since 1 byte can have 256 possible values (2^8), there can be 256 unique 1-byte files. Adding these to the one possible 0-byte file yields 257 distinct entities smaller than 2 bytes. So at most, 257 of the 65,536 (2^{16}) possible 2-byte files *could* be compressed to smaller files. But to do this, we would have to map the 1-byte and 0-byte files into the empty 2-byte slots left from the compressed 2-byte files. That is, to reduce the size of some 2-byte files, the 0-byte and 1-byte files must be allowed to grow. In this case we've done a simple swap, but the principle holds true for any compression algorithm: If you don't allow some files to become larger, there will be no smaller files available into which larger files can be mapped.

*How do compression
utilities shrink files
to half their original size
and then reliably restore
them? The trick is taking
advantage of patterns in the
files we want to compress.*

If *every possible* file could be compressed, then logically it would be possible to successively reduce all files to 0 bytes. Clearly, a 0-byte file cannot contain the information needed to restore the original, nor can it become anything but larger.

Now let's consider files of one byte. Only the 0-byte file is smaller and, as

If you ponder this problem a while, you may come up with a promising solution. Accepting that for some files to shrink other files will have to be allowed to grow in size, you start with an algorithm that does just that. Then you go a step further. If the algorithm shrinks the file, you tack a 0-bit to the start of the

compressed file. If the original algorithm makes the file larger, you tack on a 1-bit that is followed by the *original* file, unchanged. Now you have a method that will indeed sometimes increase size, but never by more than one bit!

This trick is useful; indeed, every serious compression method allows the straight *storing* of the original, unchanged file, listing the method as *stored* in the internal directory of the compressed file. But simply storing the files that would otherwise grow doesn't help much, since only a small fraction of all files can be compressed even a little.

We've already seen that only a small fraction of all possible 2-byte files can be compressed, even if we allow the smaller files to grow. There simply aren't enough smaller files. Since there are 256 values for a byte, the number of possible files of $n+1$ bytes is 256 times the number of possible files of n bytes. Thus it's never possible to compress more than $1/256$ of a file of a given size even by 1 byte!

We've seen, then, that there is simply no algorithm that can shrink all possible files of a given size. Moreover, only a tiny fraction of all possible files can be shrunk by even 1 byte, and the fraction becomes smaller as the compression factor increases. Fortunately, however, we don't need an algorithm that will compress all theoretically possible files.

A key point that underlies all compression is that the files you and I actually have on our disks are far from random. Most theoretically possible files are files we'd have no interest in at all, so we can safely let these grow and shrink only the files we care about. The secret of compression is to find an algorithm that understands how the files we normally use depart from randomness, and selectively shrinks just those.

NONRANDOM IS BETTER You can prove this to yourself by creating the short Pascal program listed in Figure 1. Running the program will produce a file of 10,000 random bytes. If you put this file through PKZIP, you'll wind up with a file of 10,112 bytes! (The ZIP overhead for a directory entry is 112 bytes.) Plainly, you've achieved no compression.

One element of nonrandomness is the uneven frequency with which various characters occur in a language. For exam-

ple, in English, the letter *e* is very common, but few words contain the letter *x*. Patterns such as these can be exploited by using variable-length coding, where the length of each character's code depends on the frequency of the character. A parable will illustrate.

The story is told of a fierce tribe of programmers, the Foobari. Their language has four letters: *a*, *e*, *i*, and *o*. At the dawn of the computer age, their standards group got together and agreed on a set of two-bit codes for their language. This FSCII code was, in binary,

```
a=00 e=01 i=10 o=11
```

A young entrepreneur, Foo Katz, determined a typical program written in Foobari was 50 percent a's, 25 percent e's, and 12.5 percent each i's and o's. Foo Katz realized if he instead used the codes

```
a=0 e=10 i=110 o=111
```

he could code a typical file in fewer bits. For 25 percent of the time he needed 3 bits instead of FSCII's 2, but 50 percent of the time, he only needed 1. So the average number of bits per character was 1.75 rather than 2—a 12.5 percent decrease in file size—and FKZIP was born.

SHANNON'S THEOREM Could Foo Katz have done better than 1.75 bits per character? Actually, given the probability of each character in Foobari, he couldn't. Work done in the late 1940s by Claude Shannon at Bell Labs shows this to be true. Shannon founded the science of information theory and proved what has come to be called Shannon's theorem.

In its simplest form Shannon's theorem says that if you have n possible characters occurring randomly but with non-uniform probabilities $p(1)$, $p(2)$, ..., $p(n)$, the average number of bits you need to code a character is

$$N = -p(1)\log_2 p(1) - p(2)\log_2 p(2) \\ - \dots - p(n)\log_2 p(n)$$

In an optimal coding scheme, then, the number of bits needed to code each character is $-\log_2 p(j)$, where $\log_2$ is the logarithm to the base 2. That is, character 1 requires $-\log_2 p(1)$ bits, character 2 requires $-\log_2 p(2)$ bits, and so on. Shannon says you cannot do any better than this. Drawing an analogy with a similar-looking quantity introduced by nineteenth century physicists studying statistical mechanics, Shannon called the quantity N the *entropy*.

As a simple example, suppose all the $p(j)$'s are equal. If there are n characters, the probability of each is $p(j) = 1/n$. Since $-\log_2(1/n)$ is $\log_2(n)$, we see that

$$N = (p(1) + p(2) + \dots + p(n)) (\log_2(n)) \\ = \log_2(n)$$

This is because, by definition, the sum of all the probabilities of the individual characters must be 1.

The Pascal test program of Figure 1 used characters chosen randomly from all 256 possible values, and we saw that the resulting file could not be compressed at all. However, if you go back to that test program and change `random(256)` to `random(16)`, the result will be different. When a number smaller than 256 is used,

TESTFILE.PAS

Complete Listing

```
var                                (* variable declarations *)
  i:word;
  b:byte;
  randfile:file of byte;

begin
  assign(randfile,'foo.bar');      (* program start *)
  rewrite(randfile);              (* give the file the name foo.bar *)
  for i:=1 to 10000 do begin      (* creates and opens file *)
    b:=random(256);               (* start loop, execute 10,000 times *)
    write(randfile,b);            (* select byte randomly from 256 choices *)
  end;                             (* write out the byte *)
  close(randfile);                (* end loop *)
end;                               (* close file *)
                                   (* program end *)
```

Figure 1: Changing `random(256)` to `random(16)` in this program listing turns the resulting file from one that cannot be compressed at all into one that can be compressed by 42 percent.



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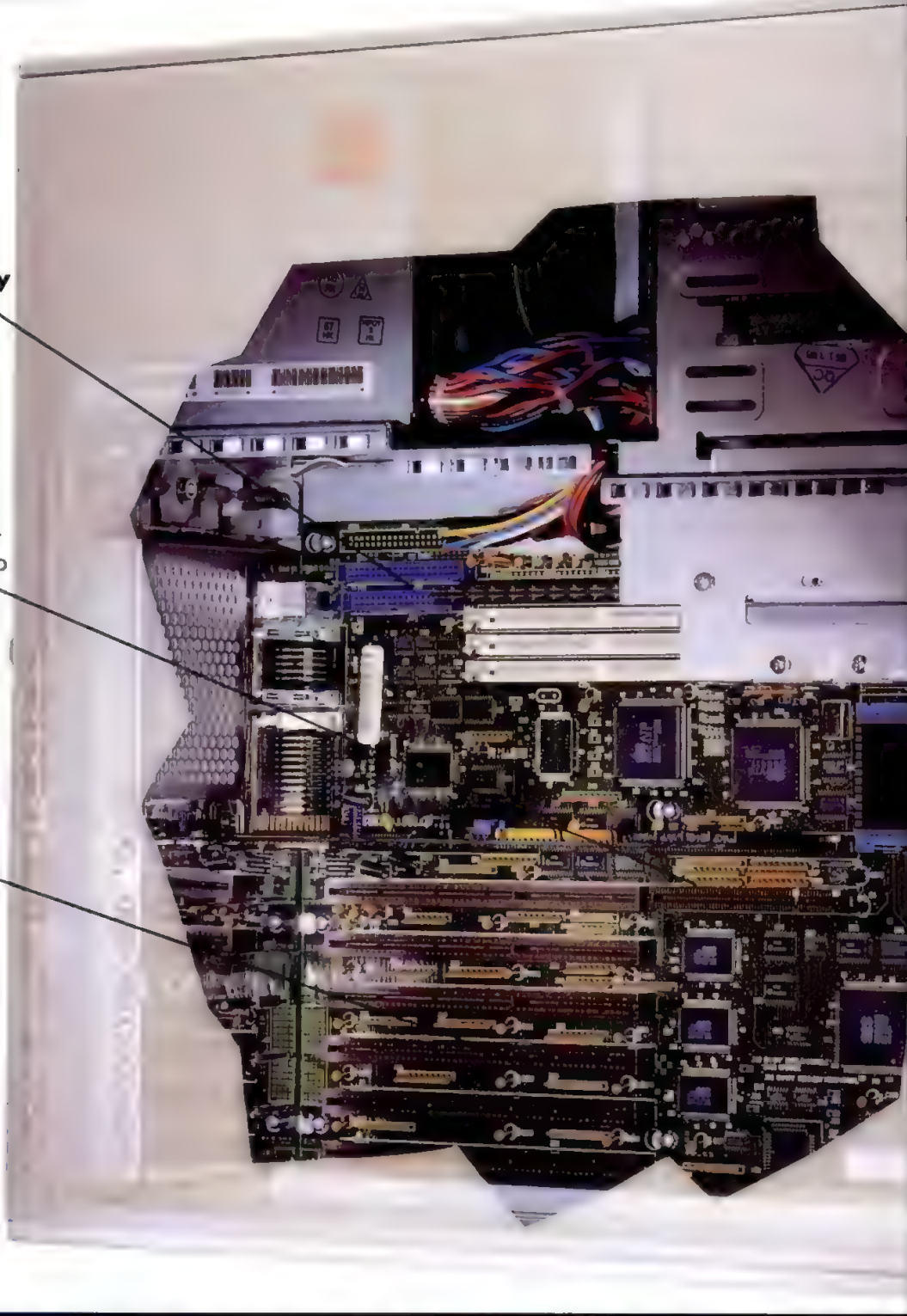
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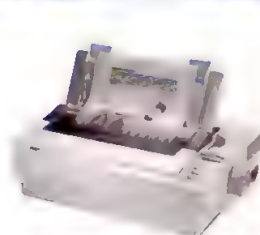
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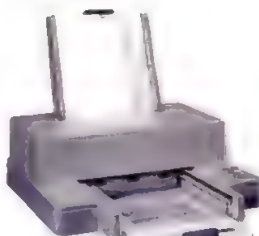
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the distribution of bytes is not random among all possibilities, even though the byte-to-byte changes are still random. Run it and try PKZIP again—you'll get a 42 percent improvement in file size (using PKZIP 2.0). The theoretical best you can hope for in the random(16) case is 50 percent. This is because only four bits are needed to generate 16 different characters ($N = \log_2(16) = 4$), and four bits are half as much as eight bits.

Now change the program line to random(200). When you run PKZIP again, you'll get a 4 percent improvement over the original. If $n = 200$, then Shannon says each character needs $\log_2(200) = 7.644$ bits, or .9554 bytes. So the theoretical maximum compression savings is 4.5 percent for the random(200) case. This shows that even a slight departure from complete randomness will permit some compression. (Of course, it's not clear how you can use fractional bits to represent something, but I'll get to that later.)

For the Foobari example, the p's are $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{8}$, and the negative logs are 1, 2, 3, and 3—exactly the number of bits in the FKZIP code that Foo Katz invented. The average number of bits needed is

$$\frac{1}{2} + \left(\frac{1}{4}\right) \cdot 2 + \left(\frac{1}{8}\right) \cdot 3 + \left(\frac{1}{8}\right) \cdot 3 \\ = 1.75$$

Thus, the Foo Katz coding did realize the theoretical maximum.

HUFFMAN ENCODING In 1952, Huffman came up with a simple algorithm that realizes the Shannon theoretical maximum when all the probabilities are negative powers of 2 (that is, powers of $\frac{1}{2}$: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and so on). Indeed, even when the probabilities are general, the Huffman algorithm works very well. It is also easy to implement in a program. Early versions of ARC, the first widely popular compression scheme on PCs, used Huffman encoding, and it remains one of the elements used in many lossless compression schemes today.

In Huffman encoding, a binary tree is used to assign codes. As depicted in Figure 2, the tree has its root on the left with the branches pointing toward the right. There are some internal nodes, which have one line coming from the left and two going off to the right; there are also

some leaves, which are nodes that have only a line from the left. The leaves are associated with the initial set of characters; there is one leaf for each character.

To form the tree, you first pick the two characters with the smallest probabilities and join them to a node. Give the node the combined probability and then look at that node and the remaining characters. Pick the two objects (nodes or unused characters) with the smallest probabilities, join them to a node, and then continue until all the characters are in the tree.

Once you have drawn the tree, you find the code for a leaf by starting at the root and recording the path to that leaf. All leaves on the top branch have a 0 for the first digit; those on the bottom branch have a 1. The number of node levels needed corresponds to the number of bits needed to code the character. Thus the complete tree shown in Figure 2 leads to precisely the coding that Foo Katz used in the Foobari parable.

In the random(200) example, no branch ends before 7 levels, so you will need a minimum of 7 bits to code each character. There are a full 128 nodes or leaves at level 7. Of these 128 items, 56 are leaves and 72 are nodes that each connect to 2 leaves ($56 + 2 \cdot 72 = 200$). Thus 144 branches end at level 8.

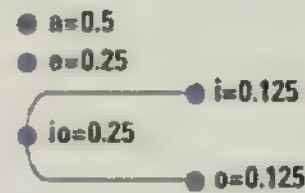
If every probability is a negative power of 2, the Huffman algorithm perfectly realizes the theoretical maximum predicted by Shannon's theorem and is thus optimal. If some probabilities are not inverse powers of 2, Shannon's maximum won't be realized, but the results are still pretty good. For example, in the ran-

How the Huffman Algorithm Works

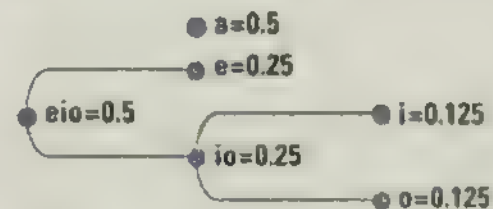
(a) Characters in language and their initial distribution:

- a=0.5
- e=0.25
- i=0.125
- o=0.125

(b) After two leaves are joined to a node:



(c) The tree is extended:



(d) The Huffman tree and its codes:

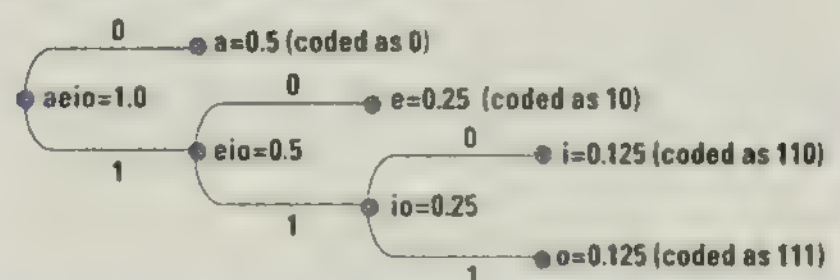


Figure 2: These tree diagrams show the successive application of the Huffman encoding system to the Foobari language.

dom(200) example, Huffman uses an average of 7.72 bits $((56 \cdot 7 + 144 \cdot 8) / 200)$, which isn't too much larger than the Shannon limit of 7.644... bits.

An alternative tree-based procedure is called Fano-Shannon encoding. Huffman starts with the leaves and combines them, building the tree from the leaves back toward the root. Fano-Shannon uses the opposite strategy: At each stage, it breaks the characters into two groups with roughly equal probabilities and builds the tree from the root toward the leaves. This method produces similar results to Huffman encoding, but some programmers may prefer implementing one over the other.

SAVING UP FRACTIONAL BITS Suppose the Foobari passed a law that henceforth every *e* was to be removed and replaced by an *a*. In that case, text documents would have 12.5 percent *i*'s and *o*'s, but 75 percent *a*'s. Since $-\log_2(.75)$ is 0.415, Shannon tells us that the optimum code length for *a* is less than half a bit. But how in the world can you code a character in less than one bit?

Remarkably, there is an elegant method that both effectively uses fractional bits and is easy to implement in algorithms. It is known as *arithmetic encoding*. Unfortunately, it has not yet found much practical use. One reason is that it was discovered rather recently—in the late 1970s—by several different computer scientists at about the same time. Thus it lacks the mnemonic value of a single name. Moreover, arithmetic encoding was not discussed in many of the books written thereafter, so many programmers have missed it. Finally, some of the early work was done at IBM, and IBM patented a specific algorithm implementing the idea. Although the idea itself cannot be patented, some programmers who might have stumbled across references to arithmetic encoding in the literature may also have heard “IBM” and “patent” and decided to go elsewhere.

Arithmetic encoding works best when character probabilities are far from equal. The revised Foobari language, in which the characters are in a ratio of 6:1:1, is a good example. To apply arithmetic encoding, you should start by thinking of the file to be compressed as a character string—for example, *aio*. You need to associate this string with a real number between 0 and 1. To do this, code the string one character at a time, using the probability of that character to home in on a real number that will represent the string. This real number is not stored as a fixed precision floating-point data type; it's stored as a base 2 number represented as a string of bits.

As we go through an example here, it may help to imagine a ruler whose subdivisions are marked off in sections proportional to the probabilities of all the characters to be used. In Foobari, then, we'd mark off $\frac{3}{4}$, and then $\frac{1}{8}$ each for *i* and *o*. We'll call the real number that will encode the *aio* string *r*.

Since the first character is *a*, the final code for our string must lie inside the *a* range, between 0 and 0.75. Now to code the *i*, which follows the *a*, we turn our attention to the *a* section of the ruler. We take that section, and divide it up proportionally ($\frac{3}{4}$, $\frac{1}{8}$, $\frac{1}{8}$), just as we did when coding the *a*. We've narrowed the range for our final code down to the *i* range: 0.5625 to 0.65625. To code the *o* that fol-

lows the *i*, we turn our attention to the *i* section, and again divide it up proportionally and select the *o* range of this section. Taking the middle value of this range, we can say that *aio* is encoded as $r = .650390625$.

For longer strings, each successive character is encoded in the same way. As you encode more characters into a single real number, the range you're using gets smaller and smaller so the number of significant digits needed gets larger. Encoding the more probable characters shrinks

*Arithmetic compression
is more effective for
probable characters because
you can encode more of
them in a given number of
significant digits.*

the range less. For example, encoding an *a* shrinks the range to $\frac{3}{4}$ of what it was, but encoding an *i* shrinks the range to $\frac{1}{8}$. Arithmetic compression is more effective for probable characters because you can encode more of them in a given number of significant digits.

USING MULTIBYTE BLOCKS Most commercially available compression programs don't limit themselves to a single method of compressing files; they make use of a variety of techniques. All the techniques we've discussed so far are examples of *static, probabilistic* encoding with single bytes. They are probabilistic because they use the likelihood of a character to determine the number of bits needed to code the character. They're static because they assume an a priori set of character probabilities and thus a fixed code. Current lossless compression technology goes beyond this kind of encoding in three ways.

- building blocks of more than one character,
- codes tailored to the file (dynamic encoding), and
- pointers to encode redundant parts of the file (Lempel-Ziv).

To determine how much redundancy

of information is in the English language, Shannon asked people to guess words from their first few letters. On this basis (and with some further analysis), computer scientists have come to believe that text files require a certain minimal number of bits per letter. Typical estimates lie in the 1.4- to 1.6-bit range, which may seem rather surprising since there are 26 letters in the alphabet. Still, based on this estimate, text files can't be compressed by more than a factor of 5 or 6 from the usual 8 bits per character.

The fact that text can actually be better compressed depends on the fact that there is much more structure to the English language than just the fact that *e* is more common than *q*. There is a tendency for *t* to be followed by *h* and then by *e*, for example, and a *q* is almost always followed by a *u*. This suggests that instead of using single bytes as the objects to be encoded, it can be useful to deal with multiple-byte blocks.

One way to do that is through *run length encoding* (RLE), which records a character and then the number of times it occurs in a string. RLE works well when there are long strings of a single repeated character, as occurs in some EXE files with preinitialized data, in some graphics files with long runs of pure white or black, and in database files with padded fields. It is rarely the best method for most files, however, because this situation is relatively uncommon. Indeed, Version 2.0 of PKZIP no longer includes an RLE method.

Another approach is a dictionary-based system. You might, for example, build a dictionary composed of the 65,280 most common words and phrases in the English language. (65,280 is 64K—64*1,024—minus 256; you need to reserve 256 entries for the ASCII codes for letters so you can handle words that are not in the dictionary.) You'd then encode a file in 2-byte pieces (16 bits are needed to address 65,536 different possibilities), where each 2-byte code corresponds to an entry in the dictionary. For words that are not found in the dictionary, this method will double the size of the space that is needed since 2 bytes must be used in order to encode each original byte. On the other hand, the encoding would replace many words of 5 or 6 or even more

bytes with codes of only 2 bytes.

Since the 64K dictionary possibilities do not occur with equal probability in files to be compressed, you could improve on this scheme by using Huffman or arithmetic encoding to further compress the first iteration of encoded text. In the first pass you'd encode the text by representing it in terms of 2-byte codes, as described above. In the next step, the most common codes would be represented by short bit-strings while the uncommon codes are mapped to longer bit-strings, causing further reduction in size.

This encoding method was used in a

***One reason compression
works is that ASCII-encoded
files have redundant
information.***

program called Stomp, which was popular on BBSs several years ago. Stomp never caught on because its method is inherently slow and has some additional limitations. It's slow because of the large number of possibilities that must be scanned. It's also limited to text files and requires a large data file (the dictionary) to be on hand. Still, the method is a likely candidate for the tightest compression of text.

DYNAMIC ENCODING Everything I've discussed so far sets up a fixed encoding mechanism for all files. But a set of probabilities that's good for text will be bad for database files, and a set of probabilities that works for database files will be bad for EXE or WK1 files. Clearly, it would be best to tailor the probabilities to the file. That's in reality what every commercial compression package does.

The simplest way to implement file-based encoding is to compute the probability distribution of the bytes used in the file and use those distributions as the basis for Huffman or Fano-Shannon encoding. However, this method requires that the file be read twice. That means it cannot be used for real-time compression applications such as modem communications or hard disk backup to tape.

To meet the demands of real-time

compression there are methods that recompute probabilities and codes as they go along. The probabilities encountered in the first part of the file are used to optimally encode the later parts. For example, the algorithm might start with an a priori distribution, and then every 256 bytes recompute the distribution based on what has gone before. These methods are called *dynamic* or *adaptive* encoding.

You might think that since the codes keep changing, dynamic encoding systems would present problems for decompression. Fortunately, however, the decompressor can always reconstruct the method the compressor used. This is because at any stage the decompressor has exactly the same information available to it that the compressor had at that stage—namely, the part of the file that has been uncompressed up to that point.

Behind much modern lossless compression is an idea introduced by Lempel and Ziv in 1977–78. This idea has been implemented with a number of variations, especially in one with some contributions by Welch, so you'll see references to the method as LZ or LZW. The basic idea is to use the file itself as a sliding dictionary as it is processed. As the compressing program is about to compress the next n bytes of the file, it looks at what it has already processed and sees if the first x characters of those bytes have occurred in the past y bytes. If so, it stores two pieces of information: a pointer to where the identical string occurred and the number of characters in the string.

For example, the algorithm might look back at the past 1,024 characters for an identical string with a length of 16 or fewer characters. In this example, 10 bits are needed to store the number from 1 to 1,024 that tells how far back the string was, and 4 bits are then needed to store the length of the string. Thus, the total number of bits needed is 14. This contrasts very favorably with the maximum of 128 bits that would be needed to represent a 16-byte string—it's a compression factor of more than 9.

It is a remarkable fact that there are enough repetitions in most files that this method is often very effective. Sometimes supplemented by a probabilistic method, it is the basis of many types of compression programs, including disk

compressors (for example, Stacker and DOS 6's DoubleSpace), archivers (for example, PKZIP, ARC, and LHA), and tape backup programs.

USEFUL REDUNDANT INFORMATION One reason compression works is that ASCII-encoded files have redundant information. Once redundancy is removed, however, changing a few bits can change the original file dramatically. For example, changing the ten-bit pointer in the LZ encoding example above could change the decompressed file by 16 bytes! And changing the four-bit length component can effect the meaning of all future pointers and so change the file even more!

For this reason, after squeezing out redundant information, a good compression program puts some redundancy back in the form of a checksum, such as a CRC (cyclic redundancy check). This lets the program warn you if the file has been corrupted in any way. The compression algorithm squeezes out a lot of useless redundancy and then puts back some useful redundancy.

In sum, the two most important techniques in lossless compression are using the nonrandom distribution of bytes within files to determine variable length coding schemes; and using the fact that there are often long repetitions of strings within a file to strip out redundancy. The first is the basis of Huffman and arithmetic coding; the second is the basis of LZ and LZW.

For further reading, I recommend you consider four books. The first two are academic computer science books, and while they are somewhat technical and dry, they also contain a great deal of valuable information. These are Bell, Cleary, and Witten, *Text Compression*, Prentice Hall, 1990, ISBN 0-13-911991-4; and Storer, *Data Compression*, Computer Science Press, 1988, ISBN 0-71678156-5. For a book written more for programmers, see Nelson, *The Data Compression Book*, M&T Press, 1992, ISBN 1-55851-214-4. Finally, for some fascinating reflections on information and data compression, take a look at Lucky, *Silicon Dreams*, St. Martin's Press, 1989, ISBN 0-31202960-8. □

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Convert Word Processor Files to ASCII with PCMCVT

BY JAY MUNRO

What do you do when you receive a document prepared on a word processing program you don't happen to have? Dozens of formatting codes for every font change, margin, and mode are embedded in the manuscript, and every one of them is worse than useless if you have to do any work on the text.

This issue's free utility eliminates this hassle. If you ever need to turn text formatted with today's most popular word processors into straight ASCII, all you need is PCMCVT. PCMCVT recognizes and converts the binary files produced by Word for DOS, Word for Windows, Windows Write, WordPerfect for DOS, WordPerfect for Windows, and Ami Pro into ASCII files.

Keeping all these different word processors on your machine would be prohibitive both in cost and disk space. Moreover, you'd have to learn enough of each of their commands to open the files you receive and then resave them in ASCII format. And you'd have to know which program to use on the document you received. PCMCVT does all this for you automatically, making it the perfect answer to word processor overload.

PCMCVT is not a memory-resident program, and it takes up very little space when it runs. This can be very handy when you want to shell out to DOS and convert an additional document without having to close the document on which you're working. Most word processors today provide a shell-to-DOS capability, and since PCMCVT weighs in at under 10K, it runs very comfortably in a DOS shell. Some word processors, such as Microsoft Word for DOS, can accept a DOS command without even requiring you to

shell out to DOS, making it possible to convert a file with PCMCVT without even seeing a DOS prompt.

The easiest way to get a copy of PCMCVT.COM and its assembly language source code is to download the file PCMCVT.ZIP from PC MagNet. Details are provided in the "PC MagNet: Utilities and More" sidebar. If you make any changes in the PCMCVT source code, you'll need MASM 6.0 or later to reassemble the program.

If you don't have a modem, we'll sup-

PCMCVT strips out all the formatting codes of today's most popular word processors, leaving you with an editable ASCII text.

ply the PCMCVT files on-disk without charge. Just send a postcard request with your name, address, and disk preference (1.2MB or 1.44MB) to the attention of Katherine West, *PC Magazine*, One Park Ave., New York, NY 10016-5802. No phone calls, please!

USING PCMCVT You should put PCMCVT.COM in a directory on your DOS path. That way you can then go to any directory and start converting files without having to move them around. You enter PCMCVT with one or more parameters, from the DOS prompt. Its complete syntax is

```
PCMCVT /S source [/D destination]
[/Wxxx] [/O] [Tx] [/?]
```

The only required PCMCVT parameter is /S source, the filename of the word-

processed document you want to convert into ASCII text. Spaces can be included between the /S and the filename but are not required. The source filename must be complete, with no wildcards or missing extensions; the Quick Reference Guide explains how to process a batch of files.

When creating a file for the converted text, PCMCVT uses the same filename as that of the source file by default, adding only the extension .TXT. Thus, if you enter

```
PCMCVT /S MYLETTER.DOC
```

the source file will remain unchanged and the converted file will be called MYLETTER.TXT. By adding the optional /D destination parameter on the command line, you can specify any legal DOS filename (including a path, if desired) for the converted file.

If a same-named file exists in the destination directory, PCMCVT will warn you and give you the choice to overwrite the file or not. If you answer No, the easiest way to reenter the command up to the

Top 10 Utilities

Rank	Utility
1	DIRMATCH - Compare 2 directories
2	BAT2EXEC - Batch file compiler
3	CHKFRAG - Checks fragmentation
4	PCSPool - Print spool utility
5	INCTRL - Installation control
6	BUGS - Windows 3.1 screen saver
7	STRINGS - Enhance batch files
8	WPRINT - Print in Windows 3.1
9	CLIPST - Extend the clipboard
10	PCREM2 - Access a remote PC

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS.

The Microsoft Word File Format

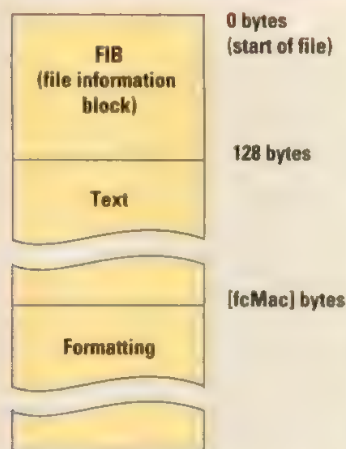


Figure 1: The basic file format of Microsoft Word is shared by Word for Windows and Windows Write.

point of typing in a new destination file name is to hit F3. If you want PCMCVT to overwrite same-named files automatically and without a warning prompt, simply include the /O switch parameter on the command line. This can be useful when you are running PCMCVT from a batch file.

To tell PCMCVT to word-wrap lines at a certain length, you use the /Wxx parameter, where xx is the maximum number of characters desired. With a setting of /W60, PCMCVT will force a new line by inserting a carriage return/line-feed (CRLF) after a maximum of 60 characters. When converting a line longer than xx characters, PCMCVT tries to find a convenient space to break the line. Thus in this example, although the specified length is 60, the line may break at 45, 52, or 59 characters, depending on where the last word space occurred. If a file contains a long, unbroken character string, PCMCVT has no choice but to break the line at the specified length.

If you enter the /W switch parameter without specifying a value for xx, PCMCVT defaults to a line length of 78 characters and replaces soft carriage returns in the original document with hard carriage returns.

By default, PCMCVT passes on the tab character (ASCII 9) to the destination file. This is not always desirable. The /Tx switch replaces tab characters with the number of spaces you specify as x.

Thus, for example, /T5 replaces all tab characters with 5 spaces, which you might use to approximate the tab spacing in the original document. If no value of x is specified, the tab is removed.

If you forget the syntax details, you can get a listing of the PCMCVT options by entering the command with no parameter or with the /? switch.

CONVERTING FILES PCMCVT can create two kinds of ASCII files. The most common (and the default) format is called "one-line-per-paragraph." In this format, everything up to a hard carriage return is considered part of a single line, no matter how many lines it may occupy on the screen. The other format inserts hard carriage returns and line-feeds at the end of each screen line, whose length is specified by the word-wrap setting as explained above.

Which format is more appropriate in a given situation depends on how the file will eventually be used. If you wish to import the converted text into a word processor, the one-line-per-paragraph format makes the most sense, as it leaves the word processor free to impose its own margin settings and reformatting on the text.

Fixed-length lines delimited by a carriage return/line-feed, on the other hand, are perfect for text files that are to be typed or browsed from a DOS prompt. README files are a good example. With the trend in shareware toward using the Windows Write format for instructions, you could preview a newly downloaded file without having to fire up Windows.

FILE FORMATS In addition to the text that you want and the formatting codes that you don't, word-processed files contain information that uniquely identifies the word processor that created them. For this reason, during the conversion process PCMCVT is able to display the name of the originating word processing system. Identifying the native document format also enables PCMCVT to use the appropriate routines to extract the text from the file.

Among the document formats PCMCVT supports—the DOS or Windows versions of WordPerfect 5.1 or later; Word for DOS, Version 5.0 or later; Word for Windows (WinWord), Version

1.0 or later; Windows Write 3.x; and Ami Pro—the three from Microsoft are very similar, so I'll discuss them first.

WORD/WINWORD/WINDOWS WRITE Since its introduction in 1983, the file format for Microsoft Word has remained unchanged. Microsoft had the foresight at that time to define structures larger than were immediately needed so that new features could be added without changing the basic format. As shown in Figure 1, a Word document file consists of three sections: the header, or *file information block*; the text section; and the formatting section. This basic file structure is shared by the three Microsoft file formats with but slight differences, which I'll discuss as they arise.

PCMCVT is concerned only with the first two sections of the Microsoft document format, that is, the FIB or file information block, and the text section. In identifying which word processor was used to create the original file, however, PCMCVT also makes use of a second identifying characteristic, called the *signature*. A file signature is usually a unique byte sequence at a specific position in the file that sets it apart from other files. In the Microsoft document files, for example, the signature is contained in the first 2 bytes, as shown below:

File format	Signature
Word 5.5	31BEh
WinWord 1.x	9BA5h
WinWord 2.0	DBA5h
Windows Write 3.1	31BEh

From the signatures alone we can tell WinWord and Word for DOS apart, but Windows Write presents a problem, as it shares the same signature with Word for DOS. This is where the reserved areas of the FIB come into play. Starting from the beginning of the file, if we look at the value of the 2-byte word located at offset 96, we'll get our answer. If the value is 0, then the file is written in Word for DOS; if it has any other value, it's Windows Write. With the type of file nailed down, we can move on to figuring out the size of the text portion.

As Figure 1 indicates, the text follows the file information block. In both Word for DOS and Windows Write the text starts 128 bytes from the beginning of the

The Signature-Checking Routine

```

;-- WordPerfect
Invoke StrCmp, Addr HeaderBuffer, Addr WPerfID,4
Or AX,AX ;StrCmp = 0 if a match
Jnz 0F ;no match
Mov AX,1 ;1 = Word Perf
Lea DX,WPerfName ;DX contains address
; source file name

Jump HeadOut
00: ;next comparison

```

Figure 2: The HeadCheck function uses this routine to determine if the word processing format of a file is one that PCMCVT supports.

file. The starting offset of the text in WinWord is specified by a word stored at offset 24 from the start of the file. Now that we know the file type and the start of the text, with one more piece of information and a bit of math, we can move on to read the text.

The actual length of the text plus the header size is stored as a DWord (double word) at offset 28 from the start of the file. By subtracting the header size (128 for Word and Write, 384 for WinWord), we get the length of the text to be converted.

Of the formats handled by PCMCVT, Microsoft's are the easiest to convert. Once the header information is gathered and the text length is determined, what is left to be read is essentially pure ASCII text. Unlike the other formats, only a few characters in the text demand special treatment during conversion.

In Windows Write, Word for DOS, and WinWord, the pair of ASCII character codes 13 and 10 (carriage return and line-feed) are used for paragraph ends; character code 12 is used for explicit page breaks; and character code 9 is used for tab characters. PCMCVT keeps all these characters unchanged in the converted text unless, of course, the /Tx switch is specified to expand tabs into spaces.

Several other special codes are used in Word for DOS and WinWord. Hard line breaks are stored as character 11, which PCMCVT replaces with a carriage return/line-feed pair. PCMCVT replaces ASCII 15, the character that Word uses for the em-hyphen, or em-dash, with two normal hyphens. Word for DOS defines the 196 as a nonbreaking hyphen and 255 as a nonbreaking space; WinWord uses ASCII 30 for a nonbreaking hyphen and ASCII 160 for a nonbreaking space. So

in these files, depending on the original format of the file—WinWord or Word—PCMCVT replaces the 30 or 196 with a character 45 (hyphen), and 160 or 255 with a 32 (space). The utility ignores all other characters with a value of ASCII 31 or less.

WORDPERFECT WordPerfect file formats are essentially the same in Versions 5.1 for DOS and in 5.1 and 5.2 for Windows. The format goes back only to WordPerfect 5.0, which represented a considerable departure from that of the earlier 4.2 version.

WordPerfect 5.x files contain a 16-byte file header, called the *prefix area*, that identifies the file and provides certain basic file information. The first 4 bytes consist of the hexadecimal value 0FFh and the three letters WPC, which comprise the signature. Although PCMCVT uses only the signature and the next 4 bytes (which point to the start of the text), the prefix area also contains information about the type of document, the version of WordPerfect that created the file, and so forth.

After the header, WordPerfect document files are not segmented in the manner of Microsoft files. Except for some initial formatting information stored in

an additional prefix area immediately after the 16-byte header, all formatting information is embedded in the document area itself. Having the formatting codes and data in the text area makes the conversion process somewhat more difficult.

WordPerfect uses both single and multibyte codes to identify functions. Single-byte codes employ some of the same control characters (ASCII values of less than 32) used in Word files. In WordPerfect, such control characters are used to signal carriage returns, page feeds, page numbers, and special merge codes. Single-byte codes in the hexadecimal range from 80h to 0BFh (128 to 191 decimal) are used to turn such functions as justification, columns, and footnotes on and off. PCMCVT traps the single-byte codes for hard hyphens and hard spaces. Hard hyphens occur in three types (in-line hyphens, end-of-line hyphens, and end-of-page hyphens) and use codes 0A9h, 0AAh, and 0ABh. Hard spaces use the code 0A0h. PCMCVT looks for these codes and replaces them with the standard hyphen (ASCII 45) and space (ASCII 32) characters. Except for hard hyphens, hard spaces, carriage returns, and page feeds, PCMCVT strips out all the rest of the single-byte code characters when it converts a file.

Multibyte functions are where the real fun starts. There are over 50 pages of documentation on the multibyte functions in the WordPerfect developers guide! These functions are of two kinds. *Fixed-length* functions use the range from hexadecimal 0C0h to 0CFh (192 to 207 decimal), and *variable-length* functions lie in the range of hexadecimal 0D0h to 0FFh (208 to 255 decimal).

The fixed-length functions begin with a code (for example, 0C1h for tab-align),

The DoTabs Procedure

```

DoTabs Proc Near Uses CX ;expands tabs
    Mov CX, TabWidth ;get tab size

TabLoop:
    Mov AL,32 ;put space in AL
    Call WriteIt ;write it to dest file
    Loop TabLoop ;go back for more
    Ret
DoTabs EndP

```

Figure 3: This procedure determines whether PCMCVT is to pass the tab character on or replace it with spaces. If the /Txr switch is in effect, DoTabs writes the correct number of spaces to the output file; otherwise it simply writes out a tab character.

which is followed by a series of bytes of data. The end of the function is signaled by a repetition of the initial code. PCMCVT recognizes only one of these functions, 0C1h, the tab-align code. While most word processors use the tab character (ASCII 9), WordPerfect signals a tab with the tab-align function. The function contains a byte that distinguishes between standard tabs and left, right, or center alignment, depending on which bits are set. PCMCVT retrieves the byte and, if the code is for tab, replaces the functions with either an ASCII 9 character, or the number of spaces if the /T parameter was used. In all other functions, PCMCVT ignores everything between the two appearances of WordPerfect's multibyte fixed-length codes.

Variable-length multibyte functions have a slightly different format. The actual size of the function is stored in the codes. These functions start with a 1-byte begin function code followed by a 1-byte sub function code. This combination ensures over 12,000 possible variations, giving WordPerfect a lot of room for expansion.

Immediately following the sub function code is a word (2 bytes) that contains the length of the function. The value represents the size of the whole function, including the beginning and the ending codes. After the length word comes the data for the function. Multibyte functions can cover a wide range of different features, such as margin commands, font changes, printer codes, and graphics information.

At the end of the code sequence, the first section repeats itself, only in reverse order. That is to say, the size word of the function is duplicated, followed by the

sub function code, and finally the function code. In its conversions, PCMCVT must ignore (that is, strip out) all the multibyte functions. Instead of examining each byte in search of the ending code, however, PCMCVT figures out the length from the size word and jumps past the function, saving the time it might take to scan through possibly hundreds of bytes.

AMI PRO Compared with the Microsoft and WordPerfect products, Ami Pro presents an unusual format: Its files consist almost completely of ASCII text. Like its competitors, Ami Pro does have a header to store information, followed by the document area. Like WordPerfect, Ami Pro also embeds formatting commands in the text area. However, the difference is that the formatting codes are set off by certain low ASCII characters such as < and @, rather than high-bit ASCII characters.

The Ami Pro signature used by PCMCVT is the text string [ver] at the very start of the file. Following the signature comes line after line of information about the file—printer last used, font information, title of file, and so forth. PCMCVT skips through all this information and searches straightaway for the Ami Pro start-of-document text string, [edoc].

The text that follows the [edoc] string stores formatting information both at the beginning and in the middle of the text lines. Simple formatting information, such as bold on and off, is signaled with <> signs surrounding a code. For example, if the single word **bold** were supposed to appear in boldface, the code below would be used:

The next word is <+!>bold<-!>

Such formatting is humanly readable. The code for boldface is the exclamation point. It is turned on with a plus sign and turned off with a minus sign.

To distinguish between formatting codes and characters that are part of the user's text, Ami Pro usually places a less-than sign (<) before the character. For example, if the text contains a less-than sign, Ami Pro prefixes it with another less-than sign. So if Ami Pro (or PCMCVT, for that matter) sees two less-than signs (<<) in a row, it ignores one and prints the other as a regular character. To signify a greater-than sign, Ami Pro uses the three characters less-than,

***PCMCVT is able to
handle critical errors itself
rather than by means of
the classic "Abort, Retry,
Ignore" message.***

semicolon, and greater-than (<;>).

Ami Pro uses a similar coding format for many features, even page breaks. Although in most word processors hard page breaks are usually an ASCII character 12, Ami Pro puts the code <:P> at the beginning of the first line of a new page instead. About the only ASCII control codes that Ami Pro uses are the carriage return/line-feeds and tab characters (ASCII 9). And again, as with all but the tab, carriage return/line-feed, and page feeds, PCMCVT reads the Ami Pro codes and skips over them, extracting only the actual text of the file.

HOW PCMCVT WORKS PCMCVT was written in assembly language, using Microsoft Macro Assembler 6.0. (Version 6.1 would work as well.) A modular programming approach was implemented for each conversion routine, so each conversion algorithm could be designed and tested independently. What follows is a broad overview of how PCMCVT works; add the complete commented assembly code (available on PC MagNet) and you'll have everything you need to understand the PCMCVT utility.

The main module of the program con-

How Word Wrap Detects Spaces

```
ScanLoop:
  Mov  AL, 32          ;load AL with space character
  RepNe ScaSb          ;scan for that first space
  Mov  AX, BX          ;get length total length (BX)
  Sub  AX, CX          ;see difference
  Mov  CurLine,AX      ;save current length
  Add  AX, LastLen     ;add in the last length
  Cmp  AX, DX          ;check length against maximum (DX)
  Jg   Decision2Make   ;jump if line is longer than width
  Mov  AX, CurLine     ;get current line length back
  Mov  LastSpc,AX      ;save it as last space found
  Jmp  ScanLoop        ;go back for more
```

Figure 4: The word-wrap routines (invoked when you use the /Wxx option) scan the text in a two-step process. This is the code for the second scan; it actually consists of a series of small scans.

■ PC MagNet: Utilities and More

The *PC Magazine* utilities are available by modem from PC MagNet, our on-line service. PC MagNet is part of ZiffNet, a group of on-line services from Ziff-Davis Publishing Company. ZiffNet is hosted by CompuServe Information Service.

THE FIRST TIME If you've never used PC MagNet, the first step is to find the access number nearest you. To do this, set your communications software to 1,200, 2,400, or 9,600 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex, then dial 1-800-346-3247 with your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the closest access number. Or you can call 1-800-635-6225 (voice) and follow the instructions. Once you have an access number, you can either join ZiffNet or just download the current utility free of charge.

HOW TO JOIN ZIFFNET To join ZiffNet, dial your local access number. At the HOST NAME prompt, enter CIS, and at the USER ID prompt, type 177000,5000. Then, when you see the PASSWORD prompt, enter PC* MAGNET. Finally, when you see the ENTER AGREEMENT NUMBER prompt, enter PCMAG93. CompuServe members can join by entering

GO PCMAG at any CompuServe ! prompt.

Register your name and enter your American Express, MasterCard, or Visa number. (If you'd like to have your company billed instead, call CompuServe at 800-848-8990.) Your personal user ID and a temporary password will be displayed. A new password will arrive in the mail within ten days to confirm your subscription.

FREE UTILITY To obtain this issue's utility free of charge: Dial your local number; at the HOST NAME prompt, type CIS; and at the USER ID prompt, enter 60116,1. Then at the PASSWORD prompt, enter PCMAGUTIL.

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MORE THAN JUST UTILITIES For a list of all the programs available on PC MagNet, download the file PCMCAT.ZIP from Library 1 (General Information) of the Utilities/Tips Forum.

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tains the routines for file handling, identifying headers, parsing the command line, word wrapping, and other support functions.

Program execution starts by revectoring INT 24h. This allows PCMCVT to handle critical errors itself rather than by means of the classic "Abort, Retry, Ignore" message. The HookInt24h and UnHookInt24h functions simply intercept critical errors and send program execution back to the calling program. Because the carry flag is set on the return, PCMCVT sees the error and can process it as needed.

As a command line program, PCMCVT needs to read and parse the parameters the user passes to it. It thus reads off-

set 80h of the Program Segment Prefix (PSP), which contains the number of command line parameters. If none are found, PCMCVT simply displays a help screen and terminates. If it finds any user-supplied parameters, it calls the ParseCommandLine function. In order to simplify the parsing process, PCMCVT first capitalizes the incoming command line string. The parsing function steps through each parameter, extracts the filenames and switches, and then stores them for later use.

The next step is to identify the source file's word processing format by examining the header and signature. PCMCVT opens the source file and reads a 256-byte chunk of the file into the HeaderBuffer.

This is more than sufficient to identify the five formats supported here, and it leaves room for expansion later. The function HeadCheck steps through the beginning of the HeaderBuffer, looking first for a WordPerfect signature, then for the signature of Word for DOS, WinWord, and finally AMI Pro. The function StrCmp is called with pointers to the HeaderBuffer looking for matches. If no matching signatures are found, PCMCVT displays the message "Sorry, unknown format" and exits.

The HeadCheck function returns a value that corresponds to the file type found. This determines which conversion routine will be called. If the value is a valid format that PCMCVT can handle,

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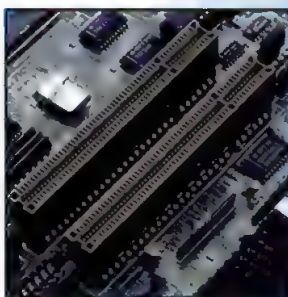
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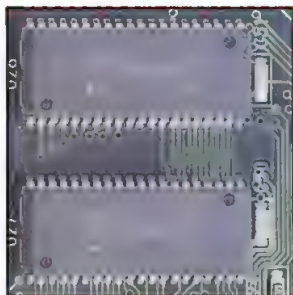
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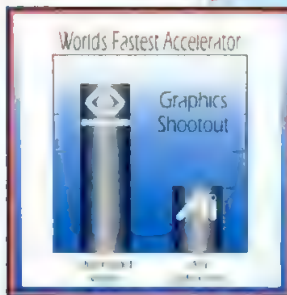
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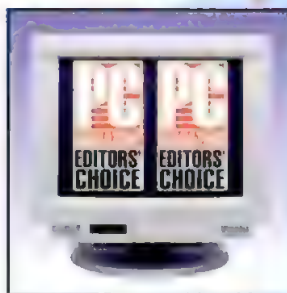
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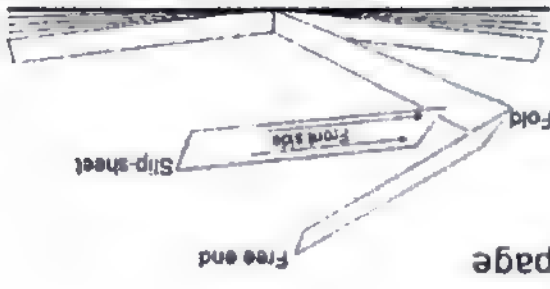


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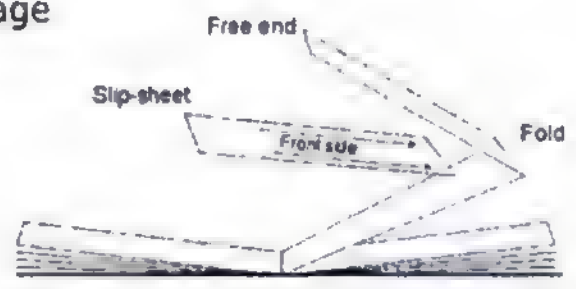
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Foldout slip-sheet

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January 26, 1993
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the destination file is opened and execution moves on to the appropriate conversion routine. The code shown in Figure 2 is the signature-checking routine that HeadCheck uses for WordPerfect. The routine is duplicated in PCMCVT, using the unique signature for each file type.

CALLING CONVERSION ROUTINES The PCMCVT conversion routines are essentially integral units that call external routines for file support and that use global data. The way text is extracted from its native file varies with the specific word processor. However, the conversion routines use similar steps, starting with finding the beginning of the text in the file.

Each module begins by getting (or calculating) the start of the text section, to which the file pointer is then reset. (The file pointer needs to be reset because it was left 256 bytes from the start by the header-reading procedure.) Once the pointer is reset, the first block of text is read into a 2,024-byte (2K) input buffer. This buffer size was chosen as a compromise between the demands of adequate workspace and the danger of hogging too much memory. If the file is less than 2K, the buffer size is adjusted accordingly. If nothing is left to read from the file, the routine will exit with an error. The file read routine is self-contained, handling errors and monitoring the amount of text input by itself.

The actual conversion process consists of a byte-by-byte comparison between the source file characters and the codes and special characters that PCMCVT recognizes. PCMCVT performs a trio of tests—Use it, Replace it, Ignore it—on each successive character (or series of characters, in the case of a multibyte function). For each file format, the decision may be different. In Microsoft Word, for example, the carriage return/line-feed (CRLF) characters are passed on to the destination (output) file. However, in Ami Pro, because each line is CRLF delimited, PCMCVT needs to check whether there is one or more than one CRLF. If there is only one, it is ignored. If there is more than one CRLF, the first is ignored but each additional one is passed on to the output.

All the conversion modules handle tabs in the same manner. When a tab character (ASCII 9) is found, the DoTabs

QUICK REFERENCE GUIDE

PCMCVT Command



Jay Munro

June 29, 1993 (Utilities)

Purpose:

To strip formatting codes from word processing documents created by Word for DOS, Word for Windows, Windows Write, Word Perfect for DOS, WordPerfect for Windows, and Ami Pro, creating a pure ASCII text file. PCMCVT can save the converted files either in one-line-per-paragraph or in user-specifiable line lengths delimited with a carriage return/line-feed. Tab characters may be retained or converted to a user-specifiable number of spaces.

Format:

```
PCMCVT /S source [/D destination] [/Wxx]
[/O] [Tx] [/?]
```

Remarks:

Entered at the DOS prompt with the name of the file to be converted as its /S *source* required parameter, PCMCVT by default produces an ASCII text with the filename of *source*.TXT. A different destination filename can be specified with the /D *destination* parameter, and both /S and /D switches accept paths as well as filenames. The *source* filename must be complete and may not use wildcards. To convert a batch of files that share, for example, a *.DOC extension, the following batch file command line can be executed:

```
FOR %a in (*.DOC) DO PCMCVT /s %a
```

The /Wxx parameter allows specifying a maximum line length of xx characters, each line terminated with a carriage return/line-feed. Line breaks are made on word spaces short of the xx value, when possible. By default, tab characters (ASCII 9) are retained in the destination file unless the /Tx is included as part of the PCMCVT command line. In that case, tab characters are replaced by x spaces. PCMCVT warns before overwriting same-named files unless the automatic overwrite switch, /O, is used. Syntax help can be obtained by entering the command without parameters or with the /? switch.

PCMCVT.COM and its assembly source files can be downloaded together as PCMCVT.ZIP from PC MagNet.

WRITE A UTILITY. WIN A FRIDGE.

THE PC MAGAZINE/ZIFFNET/SOFTWARE DEVELOPMENT CONFERENCE PROGRAMMER'S UTILITY CONTEST

If you're a developer who's written a standalone programming tool for the PC — or if you have an idea for one — you might win cold cash and a hot little appliance.

PC Magazine and ZiffNet, with the cooperation of the Software Development Conference, announce their first Programmer's Utility Contest. The winning utility program will be judged by the editors of PC Magazine for its originality, usefulness, ease-of-use, and performance, among other criteria.

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You'll never have to leave your computer again!

The winning utility will also be published in PC Magazine, and distributed electronically on the ZiffNet service. Second prizes will be awarded for the

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Winners will be announced at the Software Development '93 Summer Conference in Boston the week of August 23, and announced on ZiffNet as part of their ongoing coverage of SD '93 Summer. Entries must be post-marked by August 5, 1993. Please see the rules below for complete details.

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For more information call 415-905-2784, or write to Software Development '93, 600 Harrison Street, San Francisco, CA, 94107.



Ziff NETSM



OFFICIAL CONTEST RULES

1. To qualify, a program must be a standalone utility that boosts a programmer's productivity. It must run under: MS-DOS, version 5.0 or later; Windows, version 3.1; OS/2, version 2.x; or Windows-NT. The utility can be written in any mainstream computer language — such as assembly, C, C++, Pascal BASIC (including Visual Basic), or Smalltalk — as long as the program is a standalone executable.

Each entry must include: all files necessary to build the application; a project, Make, or batch file with which to compile the program; and the executable program. In addition, include an ASCII text file (README.TXT) with: your name, address, daytime phone number, and e-mail address (if any); the language the utility is written in; the compiler used; a five or six sentence description of what the program does; and a five to ten sentence description of how the program works.

Entries may be submitted electronically via the ZiffNet service (hosted by CompuServe) or by mail (on 5 1/4- or 3 1/2-inch high density floppy disks). To submit electronically, ZIP all files together (1.x or 2.x format) and upload to ZiffNet/CIS account number 72241,104. To submit by mail: Label the floppy disk with your name, address, and daytime phone number, and send to Programmer's Utility Contest, PC Magazine, One Park Avenue, New York, NY 10016. All entries must be time stamped or postmarked no later than midnight, August 5, 1993 and received by August 10, 1993. We cannot be responsible for lost, late, or misdirected mail.

2. Entries will be judged on the basis of originality, usefulness, ease-of-use, performance, interface design, environment integration, and code size among other criteria. One first prize will be awarded for Best Utility. The winner will receive a small, stocked refrigerator (approximate retail value \$300), a cash prize of \$500, and have his utility published in part in PC Magazine and distributed on the PC Magazine Programmer's Forum on ZiffNet. The winner will be required to submit, within 30 days of notification, documentation describing how to use the program and how it works. In the event of noncompliance, an alternate winner will be selected.

Second prizes will include: Best DOS utility, best Windows utility, best OS/2 utility, and best Windows-NT utility. Each second prize winner will receive a PC Magazine jacket (approximate retail value \$30 each), will be listed in PC Magazine as a second prize winner, and will have their program distributed in the Programmer's Forum. To be distributed on-line, winners will be required to supply documentation for using the program. All judging will be under the supervision of Ziff-Davis Publishing Company, whose decisions are final on all matters relating to this offer. Ziff-Davis is not responsible or liable for any warranty or guarantee either express or implied on any prize awarded. All winners will be notified by phone on or before August 19, 1993. Prizes will be awarded at the Software Development Conference on August 24, 1993. If a winner is unable to attend the conference, the prize will be mailed.

3. This contest is open to all U.S. citizens except employees of Ziff Communications Company and its subsidiaries, affiliates, and advertising and commercial agencies, and the families of such employees. All federal, state, and local laws and regulations apply. The contest is void where prohibited by law. All federal, state, and local taxes on the prize are the sole responsibility of the winner. The media on which entries are submitted become the sole property of Ziff Communications Company and none will be returned. By entering the contest each entrant represents, warrants, and agrees that his/her entry is original, it has been written on his/her own time, it has not been previously published or distributed, it does not infringe or violate the rights of any third party, it has not won previous prizes or awards, it does not contain faults, defects, viruses, worms or built-in time or use-driven destruct mechanisms or injurious or damaging formulas, instructions or other materials and, if the entry is selected as a first or as second prize winner, he/she will grant to Ziff Communications Company, its affiliates and designees the non-exclusive worldwide perpetual right to (a) reproduce, publish, distribute and display his/her entry and the associated documentation, as submitted, as it may be edited and/or as it may be adapted into an article by PC Magazine, in

whole or in part, in all languages, forms and media and for any purpose, including without limitation on on-line services and as premiums; and b) authorize third parties to use the entry and all associated files in the ordinary and customary way (such as downloading, loading, storing, displaying, copying, and distributing via network and otherwise). Ziff Communications Company shall not be responsible for any action by end-users which exceeds the rights granted.

The winners will be required to submit a signed affidavit certifying the above representations and warranties, and that they have followed the rules of the contest. The winners will also be required to submit a signed grant of rights as provided above. The affidavit and grant must be signed and returned within 30 days of notification. In the event of noncompliance within this period, an alternate winner will be selected. Any prize notification or prize returned to the sponsor as undeliverable will result in the awarding of that prize to an alternate winner. By accepting a prize, the winner and runners-up consent to the use of their names and entries in any manner by Ziff Communications Company and its advertising and public relations agencies and other designees without further compensation.

4. For the name of the prize winners (available after August 30, 1993), send a separate, self-addressed, stamped No. 10 envelope to Programmer's Utility Contest Winners, PC Magazine, One Park Avenue, New York, NY 10016, or see the Programmer's Forum on ZiffNet.

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routine is called. DoTabs, a simple routine as shown in Figure 3, determines whether PCMCVT is to pass the tab character on or replace it with spaces. If the /Txx switch is in effect, DoTabs writes the correct number of spaces to the output file. Otherwise it simply writes out a tab character.

To write data, whether characters or control codes, PCMCVT calls the WriteIt function. WriteIt is also self-contained. WriteIt accepts a character in AL and puts it into the output buffer. The output buffer, also 2,024 bytes (2K) long, is used exclusively by WriteIt. WriteIt monitors

*PCMCVT is designed for
quick-and-dirty text
conversion and will prove
entirely adequate for the
vast majority of your
conversion needs.*

the current character position and, when the buffer is full, writes the buffer's contents to the destination file. WriteIt can be forced to write (or flush) its buffer by calling it with a -1 in AL. The buffer is flushed when PCMCVT gets to the end of the source file.

PCMCVT reads the source file in sections. When the conversion routine comes to the end of the input buffer, a call is made to read in another piece of the file. The file-reading routine preserves all registers and updates the input buffer pointer after the file is read. The input buffer points at the current character the conversion routine is to consider. Thus, when the file-reading routine returns to the conversion module, execution can pick up exactly where it left off, except that now the input buffer has a new block of text to convert. This is important in cases like that of the WordPerfect conversion module, where the input buffer can run out of characters while in the middle of a multibyte-function-scanning loop.

If the /Wxx option was specified, the self-contained word-wrap module is

called when WriteIt writes the buffer to disk. Working with the output buffer, the word-wrap routines scan the text in a two-step process. After saving the current pointer into the output buffer, the first scan looks for carriage return/line-feeds, which signal the end of a string of characters. While scanning, the word-wrap routine counts the characters at which it looks. When it finds a CRLF, or if it comes to the end of the buffer, the number of characters is compared with the value specified on the command line. If a CRLF was found in fewer characters than the specified value, the line is printed as is and the scanning starts over again. But if the CRLF is found beyond the desired line length (/Wxx value), the second scan is performed.

The second scan, in Figure 4, actually consists of a series of small scans. The current string or line is scanned for a space (ASCII 32) or a tab (ASCII 9), which signals a break between two words. Each time a space is found, its position in relation to the start of the current string is compared with the specified line length value. If the space's position is less than the line length, the position value is saved and the string is further scanned. This continues until either a space is found with its position greater than the requested length of the line, or the end of the buffer is encountered.

Several things happen when the scanning process finds a space in the string at a position greater than the line length value. First, the value of the starting position of the current scan is retrieved. The starting value and the last space position are subtracted, yielding the number of characters in the string. This number of characters is used for the length of the line when the string is written to the output file.

Once the string of characters is written, the program writes a CRLF combination (ASCII 13 and 10) to the destination file, completing the line. When the CRLF writing is done, the program clears the current character counter and stores the last space's position in the starting position variable, and then the scanning process starts all over again.

A slight variation on the previous procedure is required when the routine runs out of characters at the end of the output

buffer before either a CRLF or the specified line length is reached. In this case, the current line is written to the destination file without a CRLF. The length is stored and the word-wrap procedure returns to the main program. Since the files are read and written in small sections, the next time the word-wrap function is called, it picks up where it left off and maintains the correct line length throughout the conversion.

When PCMCVT finishes converting the file, it closes all files and returns to the command prompt. The utility also returns errorlevel codes for use in batch files. If the conversion was successful, the return code is a 0. The other errorlevel exit codes are shown below:

Error-level code	Meaning
1	Source file not found
2	Destination existed, not overwritten
3	Drive not ready
4	Disk full

CAVEATS PCMCVT is designed for quick-and-dirty text conversion. Given the complexity of today's word processors, you may occasionally run into a file that either will not convert, or will convert very oddly. One format that does not convert well with PCMCVT, for example, is WinWord's so-called *fast save format*. This format keeps text in the original text area, but it also incrementally saves text in the area after the formatting area. While you're unlikely to receive a Winword document you need to convert that has not been saved in the regular manner, if you hit one saved in the fast save format you'll have to consult WinWord help.

Other casualties of stripping out formatting codes are headers and footers. The loss of formatting on outlines or tables could render the text unreadable. Fortunately, PCMCVT will prove entirely adequate for the vast majority of your conversion needs. □

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Implementing Macros In Your Help Files

BY RAY DUNCAN

In the last four installments of this column, I've discussed many different aspects of the Windows 3.x help system: how to design a help file, how to encode the source text for a help file, how to turn the source text into a compiled help file that can be displayed by the universal help viewer (WINHELP.EXE), how to integrate the help facility into your application, and how to enhance your help file with hyperlinks, bitmaps, pop-up windows, and secondary windows. In this installment, I'll address one of the most obscure yet powerful features of the help system: the so-called help macros.

HELP MACROS ARE NOT MACROS The terminology used in the Microsoft help compiler documentation is unnecessarily confusing. We are used to thinking of a macro as an arbitrary sequence of operations, assembled from standard operators or commands supplied by the environment, and invoked by a programmer-specified name. A help system macro, on the other hand, is essentially a function call with parameters that are specified by the help file's author. Perhaps Microsoft decided that the concept of a function call was just too arcane for help file authors, or perhaps some Excel developers got involved in the original help system documentation by accident. In any event, there seems to be little reason for Microsoft to perpetuate this daffy terminology at this late date. The macros that are built into the help system can be divided into seven groups:

- *Button macros* control the appearance and actions of the buttons on the WINHELP.EXE button bar.
- *Menu macros* control the appearance and actions of the items on the WINHELP.EXE menu bar.
- *Linking macros* provide a more flexi-

ble form of hyperlinking between hot spots and topics.

- *Window macros* control the size and appearance of WINHELP's main and secondary windows.
- *Keyboard macros* control the association between accelerator keys and help macros.
- *Auxiliary macros* launch applications or register dynamic link libraries.
- *Text-marking macros* establish, remove, test for the existence of, or jump to bookmarks within the viewed text.

Figure 1 lists the macros in each of the above groups.

Help system macros are written almost exactly like C function calls: A func-

*Help macros are a powerful
feature of the help system.
Here's how to use them in
your help files.*

tion name followed by a pair of parentheses enclosing from none to several parameters, separated by commas. Parameters can be single- or double-precision signed or unsigned integers, or string constants. For example, the macro

```
JumpContents("MYAPP.HLP")
```

causes the help file viewer to display the *Contents* topic of the file MYAPP.HLP in its main window, replacing the previous contents of the window. Within string parameters, special characters are specified using the backslash as an escape, again much like C language syntax. For example, if you wanted to include a path-name in the JumpContents() macro, you'd write it like this:

```
JumpContents("C:\\MYDIR\\MYAPP.HLP")
```

Macros can be strung together, delimited by semicolons, to define a sequence of actions—much like C program statements. (Luckily, Microsoft didn't elect to refer to such a sequence as a macro-macro!) Macros can also be nested like C function calls; in other words, the *value* of a macro can be used as the parameter of another macro. This is particularly handy when using the IfThen() or IfThenElse() macro to control flow of execution within a sequence of macros. Unlike C functions, however, macro names are not case-sensitive, and the types of parameters that can be passed to a macro are severely restricted; custom data types, pointers, and structures are not supported.

ENCODING MACROS IN THE HELP FILE

You can have a macro or a series of macros execute in several different ways:

- when a help file is first opened by the viewer application;
- when a specific topic within a help file is selected;
- when a hot spot is clicked by the user;
- when a button or menu item is selected by the user;
- when requested by the application program that launched the viewer and selected the help file.

The first case, where a macro or series of macros is executed when a help file is opened, feels the most like writing a traditional program. Add a section to the help project (.HPJ) control file called [CONFIG] and list the macros after that, one per line, in the order that you want them to be executed. Assume that an .HPJ file contained these lines:

```
[CONFIG]
BrowseButtons()
HelpOnTop()
ExecProgram("notepad.exe", 0)
```


Each time the help file compiled using this .HPJ file is opened by WINHELP.EXE, the macros following [CONFIG] will execute to enable the *browse* buttons on the button bar, toggle the *always-on-top* state of the help viewer's main window, and launch the *notepad* utility with the default window size and position.

The next case, executing a macro when a topic is selected, is implemented through the help file viewer's now-familiar, magical treatment of topic footnotes. At the beginning of the text of the topic you're concerned with, you insert a footnote with the special indicator character ! in much the same fashion you assign a title to a topic with a \$ footnote, keywords with a K footnote, or a context string with a # footnote. The contents of the ! footnote are the macro or sequence of macros (separated by semicolons), up to a limit of 512 characters. The macro (or macros) is executed each time the topic is selected and before it appears in the help viewer's window, regardless of the way the topic was reached (by hyperlink, browse buttons, search dialog, history list, and so on).

The third situation, executing a macro when a hot spot is clicked by the user, is implemented in almost exactly the same way as a hyperlink. First you identify the text or bitmap that will become the hot spot as seen in the help file viewer and format it with a double-underline. Next, you insert the character ! followed by the macro immediately after the double-underlined text with no intervening space. And finally, format the ! character and macro as hidden text.

Macros can be attached to accelerator keys, standard or custom buttons, or menu items with the aid of the following macros:

- **AddAccelerator()** associates a macro with an accelerator key.
- **CreateButton()** adds a button to the button bar and associates it with a macro.
- **ChangeButtonBinding()** associates a macro with an existing button.
- **InsertMenu()** adds a new pop-up menu to the menu bar.
- **AppendItem()** adds an item to an existing pop-up menu and associates it with a macro.
- **InsertItem()** inserts an item on an exist-

ing pop-up menu and associates it with a macro.

- **ChangeItemBinding()** associates a macro with an existing menu item.

These macros operate pretty much as you'd expect, although the Microsoft documentation fails to explicitly list the identifiers for the standard WINHELP.EXE buttons and menu items. (Actually, Microsoft Help System documentation has many surprising gaps, not the least of which is the dearth of any instructions on how to use the help compiler or a list of its switches and command line parameters!)

The last case I mentioned, execution

of a macro by the application that owns the help file, is implemented with the omnibus WinHelp() API function. First, if WINHELP.EXE is not already running, WinHelp() is called with an application window handle, a far pointer to an ASCIIZ string that contains the path-name of the help file, and a command such as HELP_CONTEXT or HELP_CONTENTS to launch the viewer and open the help file. Then WinHelp() is called again with the same window handle and help filename pointer, along with the additional parameters HELP_COMMAND and a far pointer to an ASCIIZ string that contains the macro or macros

Windows 3.x Help System Macros

1 of 2

Button macros

Back()	Displays the previous topic in the back list.
BrowseButtons()	Adds the Browse buttons to the Help button bar.
ChangeButtonBinding()	Changes the assigned function of a Help button.
Contents()	Displays the Contents topic of the current help file.
CreateButton()	Creates a new button and adds it to the button bar.
DestroyButton()	Removes a button from the button bar.
DisableButton()	Disables a button on the button bar.
EnableButton()	Enables a disabled button.
History()	Displays the history list.
Next()	Displays the next topic in a browse sequence.
Prev()	Displays the previous topic in a browse sequence.
Search()	Displays the Search dialog box.
SetContents()	Designates a specific topic as the Contents topic.

Menu macros

About()	Displays the About dialog box.
Annotate()	Displays the Annotate dialog box.
AppendItem()	Appends a menu item to the end of a custom menu.
BookmarkDefine()	Displays the Bookmark Define dialog box.
BookmarkMore()	Displays the Bookmark dialog box.
ChangeItemBinding()	Changes the assigned function of a menu item.
CheckItem()	Displays a check mark next to a menu item.
CopyDialog()	Displays the Copy dialog box.
CopyTopic()	Copies the current topic to the Clipboard.
DeleteItem()	Removes a menu item from a menu.
DisableItem()	Disables a menu item.
EnableItem()	Enables a disabled menu item.
Exit()	Exits the Windows Help application.
FileOpen()	Displays the Open dialog box.
HelpOn()	Displays the How To Use Help file.
InsertItem()	Inserts a menu item at a given position on a menu.
InsertMenu()	Adds a new menu to the Help menu bar.
Print()	Sends the current topic to the printer.
PrinterSetup()	Displays the Print Setup dialog box.
SetHelpOnFile()	Specifies a custom How To Use Help file.
UncheckItem()	Removes a check mark from a menu item.

Figure 1: The macros supported by the Windows 3.1 help compiler (HC31.EXE) and help file viewer.

Windows 3.x Help System Macros

2 of 2

Linking macros

JumpContents()	Jumps to the Contents topic of a specific help file.
JumpContext()	Jumps to the topic with a specific context number.
JumpHelpOn()	Jumps to the Contents of the How To Use Help file.
JumpId()	Jumps to the topic with a specific context string.
JumpKeyword()	Jumps to the first topic containing a specified keyword.
PopupContext()	Displays the topic with a specific context number in a pop-up window.
PopupId()	Displays the topic with a specific context string in a pop-up window.

Window macros

CloseWindow()	Closes the main or secondary help window.
FocusWindow()	Changes the focus to a specific help window.
HelpOnTop()	Places all help windows on top of other windows.
PositionWindow()	Sets the size and position of a help window.

Keyboard macros

AddAccelerator()	Assigns an accelerator key to a help macro.
RemoveAccelerator()	Removes an accelerator key from a help macro.

Auxiliary macros

ExecProgram()	Starts an application.
RegisterRoutine()	Registers a function within a DLL as a help macro.

Text marker macros

DeleteMark()	Removes a marker added by SaveMark().
GotoMark()	Executes a jump to a marker set by SaveMark().
IfThen()	Executes a help macro if a given marker exists.
IfThenElse()	Executes one of two macros if a given marker exists.
IsMark()	Tests whether a marker set by SaveMark() exists.
Not()	Reverses the result returned by IsMark().
SaveMark()	Saves a marker for the current topic and help file.

to be executed. For example, the two program statements

```
WinHelp(hWnd, "myapp.hlp",
HELP_CONTENTS, 0L);
WinHelp(hWnd, "myapp.hlp",
HELP_COMMAND, (LPSTR) "Search()");
```

will launch WinHelp, display the contents topic of the file MYAPP.HLP, and activate the search dialog. Note that although there is no obvious reason why it shouldn't work and no mention in the documentation that it won't work, the help file viewer doesn't allow you to open the help file and execute a macro with a single WinHelp() call.

CALLING DLL FUNCTIONS Although macro statements may look like C function calls, they cannot actually be laid down by the help compiler in the .HLP file as function calls. After all, function

calls are executable code and a help file is merely data. So the help compiler and help file viewer would seem to work together as follows:

- The help file compiler first translates each help macro to an intermediate form in the compiled help file, most probably into a token that represents the function to be called followed by literal strings that represent the parameters that are to be passed to the function.
- When the help file viewer encounters the macro, it uses the function token as an index into an internal lookup table containing far pointers and parameter information.
- The help file viewer interprets the macro's parameters using values in the lookup ta-

ble, translating numeric values from their string representations into binary and pushing them onto the stack, and pushing near pointers to string parameters.

- The help file viewer extracts the entry point for the procedure that implements the macro from the lookup table, and calls the procedure.

This procedure may seem somewhat complex and roundabout, but we know that the help file viewer uses some scheme like this for the simple reason that the lookup table of functions is extensible! Specifically, HC31.EXE and WINHELP.EXE allow you to dynamically link to any arbitrary DLL while a help file is being viewed, and then invoke any exported function within that DLL as a macro.

The potential of this facility is enormous. In effect, you can use a help file as a sort of simple shell or front end to any application that can be embedded in a DLL. The user invokes the functionality of the application by clicking on help file hot spot text or bitmaps, activating macros that are actually DLL function calls. Once the DLL is in control, it has full access to the Windows API and can carry out operations of arbitrary complexity. It can also perform a callback into WINHELP to access the contents of the help file that is being viewed.

The crucial macro that enables runtime dynamic linking under the control of a help file is called RegisterRoutine(). This hybrid beastie is rather like a C function prototype and Windows API function calls to LoadLibrary() and GetProcAddress() rolled into a single package.

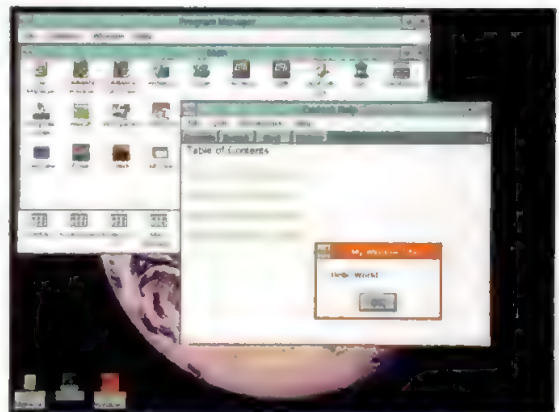


Figure 2: This screen shows the results when you use the RegisterRoutine() macro and a text hot spot to run the Windows API function MessageBox() from within a help file.

The first parameter to `RegisterRoutine()` is the filename of a dynamic link library (the extension DLL is assumed), which must be locatable by Windows using its usual search strategy. The second parameter is the name of a DLL function, which must have been declared with the far pascal calling convention and exported in the DLL's module definition (DEF) file. The third parameter to `RegisterRoutine()` is a "prototype" string that specifies the parameters for the function being invoked in a compact, cryptic notation.

The "function prototype" string supplied to `RegisterRoutine()` is built from one or more characters in this set:

u—unsigned short integer (16 bits)
 U—unsigned long integer (32 bits)
 i—signed short integer
 I—signed long integer
 s—near pointer to an ASCII string
 S—far pointer to an ASCII string
 v—void

We can easily demonstrate the DLL function call capability of help file macros with the aid of the Windows API function `MessageBox()`. `MessageBox()` is often used in applications for alert or warning dialogs and simple user interactions be-

cause it hides the dialog box functionality of Windows behind a single, simple-to-use function call; it allows an application to create a dialog box with one of several combinations of buttons, specify the text contents and title of the dialog window, and retrieve the result of the dialog without any need for an application-specific dialog message handler. The `RegisterRoutine()` macro for the Windows API function `MessageBox()` looks like this:

```
RegisterRoutine("USER.EXE",  
  "MessageBox", "uSSu")
```

The most convenient way to prepare for use of a DLL in a help file is to put all of the necessary `RegisterRoutine()` statements in the [CONFIG] section of the .HPJ file, so that the dynamic links are established when the help file is first opened. The registered functions within the DLL can then be used freely in macros attached to topics or hot spots at any point throughout the viewing of the help file. For instance, the `MessageBox()` function could be invoked by the following macro:

```
!MessageBox(0, "Hello,  
World", "My Window Title", 0)
```

The result of appending this macro as hidden text to a double-underlined text hot spot, compiling the help file, viewing the help file, and clicking the hot spot text to run the macro is shown in Figure 2. Incidentally, the help file compiler and the help file viewer support some "magic" names or symbols that supply vital values for use in DLL function calls, such as the symbol `hwndApp`, which is replaced at runtime by the handle for the main help window, and the symbol `qchPath`, which is replaced at runtime by a far pointer to an ASCII string containing the fully qualified name of the current help file.

HELP SYSTEM ODDS AND ENDS After my complaints about the help compiler `HC31.EXE`'s tendency to run out of memory on any nontrivial compilation, several people were kind enough to send me e-mail about a special version of the help compiler called `HCP.EXE`. `HCP.EXE` is built on top of Phar Lap's 286 DOS extender and can make use of extended memory that is provided by a VCPI- or DPMI-compatible memory manager; it works extremely well in a Windows 3.1 DOS box. You can download `HCP.EXE` from the Microsoft Library Forum on CompuServe: Enter GO MSL at the ! prompt; then choose 1, browse through files, using the keyword HCP to locate the exact filename of the .ZIP file containing `HCP.EXE` and `HCP.ERR`.

While doing a different sort of browsing, I ran across a technical note on the Microsoft Developer CD-ROM that spelled out the limitations of the help compiler and the help viewer in a refreshingly candid and detailed manner. This information is summarized in the sidebar "Help Compiler Limits." I must emphasize again the tremendous value of the MSDN CD-ROM to any software developer: It will probably pay for itself the first time you use it. The MSDN program is now out of the beta phase and costs \$165 per year; you can subscribe by calling 800-759-5474.

THE IN BOX Please send your comments, suggestions, or questions to me at any of the following e-mail addresses:
 PC MagNet: 72241,52
 MCI Mail: rduncan
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■ Help Compiler Limits

Here are the restrictions and limitations of the Windows 3.1 help file compiler and help file viewer:

- Maximum paragraph size (including embedded bitmaps): approximately 32,000 bytes
- Maximum string length for topic title: 127 characters
- Maximum topics per RTF source file: approximately 32,700
- Maximum topics per help file: 42,000,000
- Maximum by-reference bitmaps per help file: 32,767
- Maximum help file size: approximately 2,157,000,000 bytes (2 gigabytes)
- Keywords per help file: limited only by file size
- Maximum keyword length: 255 bytes

- Maximum topics per keyword: 32,767
- Maximum topics in Search dialog box: 400
- Browse sequence length: limited only by the number of topics
- Bookmarks per help file: limited only by file size
- Maximum annotations per topic: 1
- Maximum annotations per help file: 32,767
- Maximum history list length: 40 topics
- Maximum text that can be copied to Clipboard: limited only by machine memory
- Maximum macro length: 512 characters
- Main windows per topic: 1
- Secondary window types per topic: 5

A computer monitor with a dark frame is shown against a yellow background. The screen displays an email message. At the top, it says "E-MAIL MESSAGE". Below that, the text reads: "**FACT:** At **CDW®** each of our employees are worth \$1 Million in sales." followed by "**BENEFIT:** You receive additional savings as a result of **CDW®**'s "state-of-the art business systems and our motivated employees!".

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WP WIN V1.02 NODE W/DCC	71.18
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Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

PCs

DETECTING ELECTRO-MAGNETIC INTERFERENCE

❓ When I work in text mode on my new local-bus 486 system, the characters on-screen shake from left to right. The 14-inch SVGA monitor worked fine when I tried it at my friend's house with his system, so I tried a different monitor at home (a larger NEC 4FG) but the problem was even worse. A technician at NEC suggested I use a lower resolution, but that didn't help either. There are high-tension wires outside my house; could they be causing the problem? If so, is there anything I can do to solve it?

P. Daniel
Avenal, New Jersey

► **PC MAGAZINE:** The evidence points strongly toward local electromagnetic interference (EMI) in your home.

First, although it's unlikely that both of your monitors are defective, you might want to test them outside of your home just to make sure.

The next step is to set up your system in other locations in your house. I suspect that the source of interference may be more localized than the power lines outside. Try it upstairs and in the basement, and see if the problem changes. If not, try moving the monitor away from the computer (to one side or the other). I once encountered a monitor that gave off so much interference that the computer couldn't boot when the monitor was sitting on the case. It's possible your computer is so poorly shielded that you're having the same problem. Finally, try covering all but the front of the monitor with aluminum foil. I know this sounds like something out of a Woody Allen movie, but the foil will provide additional shielding and should help you determine whether the problem comes from outside or inside the monitor. This is only a temporary, diagnostic solution—the air vents

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Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

in the monitor's case must remain uncovered to cool the components inside, so don't leave the foil on permanently.

If none of this helps, you should test the AC power in your house. Use a line-voltage monitor to test your household power, or get a voltage regulator to stabilize it. Bear in mind that it doesn't cost much more to buy a standby power supply with a built-in voltage regulator.

—Alfred Poor

Peripherals

PRINTING THE RIGHT FONT

❓ The manual for my LaserJet Series II printer lists Escape codes for light, medium, and bold print. The bold and medium print commands work just fine, but the light print doesn't look any different from the medium setting. Is there any way to make this work?

Leo Morgan
Peabody, Massachusetts

► **PC MAGAZINE:** The crux of the problem is the way the Printer Control Language (PCL) handles fonts.

The LaserJet II uses PCL 4, which can use only bitmapped fonts, so each character has to be fully defined before the printer is able to print it.

The factors that make up a font's definition include the typestyle (how the letters are shaped), whether the characters are upright or italic, the size of characters (generally measured in terms of points), whether characters are monospaced (like Courier) or proportionally spaced (like Times Roman), and the stroke weight (light, medium, or bold).

When the computer instructs the printer to use a certain font, the printer will do its best to match the request with the fonts it has available. To do this, the printer considers these factors (in descending order of priority):

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- Orientation (portrait or landscape)
- Symbol set
- Spacing style
- Print pitch (monospaced fonts only)
- Character height
- Character style (upright or italic)
- Stroke weight
- Type style (such as Times Roman or Courier)

If the printer finds a match for a given factor, it goes on to the next. If it can't, it finds the closest match among the fonts available.

Mr. Morgan's LaserJet II prints medium- and bold-stroke characters, but not light stroke, because there are no light-stroke fonts defined in the fonts included with the printer. It uses the middle stroke weight instead, since that is the closest match.

To get more fonts for your printer, you must either add font cartridges or download fonts from your computer. Font cartridges tend to be a better solution, since they don't take up any of the printer's memory and are available as soon as the printer warms up. Downloaded fonts do take up memory, and must be copied from your computer to the printer every time you start it up.

All LaserJets after the Series II use the new PCL 5. This language has the ability to automatically scale characters—meaning it can create them in a wide range of sizes—from outline fonts instead of the more restrictive bitmapped fonts used by PCL 4 printers. But you still can't create different stroke weights or character styles automatically; if you want an italic or bold font, you must have the appropriate font outline available.

You can purchase cartridges that add PCL 5 capabilities to LaserJet II printers as well as cartridges that will add new font outlines to PCL 5.—*Alfred Poor*



OPTIMIZING DOS CONFIGURATION FILES

Figures 1 and 2 show copies of my CONFIG.SYS and AUTOEXEC.BAT files. Can you tell me the best way to or-

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der or optimize these files? If I were to add a SoundBlaster board and CD-ROM drive, where should the device drivers go? And if I wanted to add an Intel SatisfAXtion Modem/100 board, where should I load the TSR fax programs?

John Hong Chin
San Francisco, California

► **PC MAGAZINE:** Unfortunately, there's no single answer to your question. When you're loading programs high, the order in which you load them may determine whether or not they fit in high memory. For example, suppose you have two upper memory blocks (UMB) available, the first 48K in size and the second 64K. Suppose further that you want to load the three programs, A (18K), B (32K), and C (44K). If you load them in the order A, B, C, then A will occupy the first UMB, leaving 30K in that UMB. B won't fit in 30K, so it occupies the second UMB, leaving no room for C. But if you load the programs in the reverse order, C will occupy all but 4K of the first UMB, leaving enough room in the second for both B and A.

Another problem involves programs or drivers that require more memory at

loading time than they do once they're resident. If such a program can be loaded high at all, it usually must be the first program loaded.

To place a new driver or TSR in your configuration correctly, you'll have to try a location, reboot, and then examine the output of the MEM /C command to determine whether all of your TSRs and drivers loaded high. If not, you may be able to fit them all by juggling the loading order. It's possible, though, that there simply isn't room for another TSR or driver. In that case, you'll want to move the smallest item from UMB memory to conventional memory by changing DEVICEHIGH= to DEVICE= or by removing LOADHIGH from its command line. If doing this lets all the other drivers load high, you're in good shape. If not, move the smallest item back to UMB memory and move the next smallest out to conventional memory. It's a trial and error process, no question.

There are ways you can economize on memory in general. For example, you should load all of your TSR programs at the start of your AUTOEXEC.BAT, before setting any environment variables like PROMPT, PATH, or TEMP. With

No strings attached.

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CONFIG.SYS

Complete Listing

```

DEVICEHIGH=C:\DOS\HIMEM.SYS
DEVICEHIGH=C:\DOS\EMM386.EXE NOEMS X=C000-CBFF I=D000-EFFF FRAME=CC00
DOS=HIGH,UMB
SHELL=C:\DOS\COMMAND.COM C:\DOS\ /P /E:1024 /F
DEVICEHIGH=C:\UTILITY\NNANSI.SYS
DEVICEHIGH=C:\DOS\RAMDRIVE.SYS 1440 /E
FILES=30
BUFFERS=30
STACKS=9,256

```

Figure 1: A sample CONFIG.SYS file that loads DOS high and provides upper memory blocks for loaded devices and TSRs.

AUTOEXEC.BAT

Complete Listing

```

@ECHO OFF
PROMPT SP$G
PATH=C:\;C:\DOS;C:\UTILITY;C:\WINDOWS;C:\PCPLUS
SET PCPLUS=C:\PCPLUS
SET CPBACKUP=C:\DRIVED\CPBACKUP\DATA
SET TEMP=C:\DOS
LH C:\DOS\DOSKEY.COM
LH C:\DOS\SMARTDRV.EXE C+ B- 1024

```

Figure 2: A sample AUTOEXEC.BAT that sets several environment variables and loads two TSRs into upper memory blocks.

the path unavailable, you'll have to spell out the full pathname for the TSRs. Also, consider whether you actually need 1,024 bytes of environment space. You may be able to set the /E: parameter on the SHELL= line to a smaller value. You can save some more conventional memory by setting your FILES= line to 8 and using the *PC Magazine* utility UMBFILES to add more file handles in upper memory. For further reading on these and other memory issues, see *PC Magazine Guide to DOS 5 Memory Management*, by Jeff Prorise (Ziff-Davis Press, 1992).

—Neil J. Rubenking

MyQuestion®, is there a way to ensure that the copyright symbol stays on the same line as the word it's referring to?

Randy Roth

Stevensville, Michigan

► **PC MAGAZINE:** The answer in the first situation is pretty basic, in that a non-breaking space is a built-in, fully documented feature in WinWord. To enter a nonbreaking space, simply press Ctrl-Shift-Spacebar. WinWord also offers a nonbreaking hyphen, useful for keeping such terms as 1-2-3 together. To enter a nonbreaking hyphen, press Ctrl-Shift-Hyphen.

The second situation is more interesting since, for word-wrap purposes, WinWord will treat any character entered with the Insert | Symbol command as a separate word. The problem is that Insert | Symbol does not insert a character as such; instead, it inserts a field. If you enter a copyright symbol with the Insert | Symbol command, for example, and then tell WinWord to show field codes (by choosing View | Field Codes), you'll see that what actually gets entered is the field code:

```
{SYMBOL 227 \f *Symbol*}
```

If you enter it as a character, however, WinWord will treat it just like any other character.

To enter the copyright symbol as an actual character in WinWord, turn on NumLock, hold down the left Alt key, type 0169 on the numeric keypad, then release the Alt key. (Note: It's important that you remember to type the 0. If you just type 169, you'll get an underline character. If you have a list of high-order characters handy, use the 0 when you want to specify ANSI characters; leave it off when you want the IBM extended ASCII characters.)

Another choice is to use the Windows 3.1 Character Map utility. Character Map looks a lot like the WinWord Insert | Symbol dialog box. You can use it to select the character (or characters) you want, copy them to the Clipboard, and then paste them into your WinWord document from the Clipboard. The procedure is a little clumsy, but it's useful if you don't know the ASCII or ANSI number that represents the character you want.—M. David Stone

Spreadsheets

MULTIPLE LOOKUP TABLES IN 1-2-3

❗ **TIP** Lotus 1-2-3's @VLOOKUP function lets you get values from a single table. But if you need to refer to different tables, the situation gets tricky.

My solution is to use @VLOOKUP with @@ and range names. For example, in the worksheet shown in Figure 3, each employee belongs to a particular department with its own pay scale.

For the sake of simplicity, the example uses only two departments—ADM and PROD. The range B11..C17 has been named ADM, and the range E11..F19 has been named PROD. Cell F2 in the HRATE column contains the function @VLOOKUP(E2,@@(D2),1).

Instead of referring directly to a lookup table, this function refers to cell D2 and lets D2 name the table that is going to be used. This arrangement gives me a lot of flexibility. If an employee moves to another department, I have

Word Processing

KEEPING TEXT ON ONE LINE IN WINWORD

❗ Is there a way in Word for Windows 2.0 to specify that a series of words or characters should not be split? For example, when talking about *1 Samuel*, from the Bible, is there a way to ensure that both *1* and *Samuel* stay on the same line? Or when using a copyright symbol as in



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EMP#	NAME	NAME	DEPT	SCALE	HRATE
12	Brown	Paul	ADM	6	16.25
34	Base	Peter	PROD	1	9.50
54	Young	Mary	ADM	7	17.00
13	White	Claude	PROD	2	10.00
7	Miller	Bill	PROD	4	11.00
8	Benjamin	Gwen	PROD	5	11.50

ADM		PROD	
1	12.50	1	9.50
2	13.25	2	10.00
3	14.00	3	10.50
4	14.75	4	11.00
5	15.50	5	11.50
6	16.25	6	12.00
7	17.00	7	12.50
8		8	13.00
9		9	13.50

Figure 3: The formulas in column E use the @@ function on the entries in column D to determine which pay-scale table to use in looking up an employee's hourly pay rate.

EMP#	NAME	NAME	DEPT	SCALE	HRATE
12	Brown	Paul	ADM	6	16.25
34	Base	Peter	PROD	1	9.50
54	Young	Mary	ADM	7	17.00
13	White	Claude	PROD	2	10.00
7	Miller	Bill	PROD	4	11.00
8	Benjamin	Gwen	PROD	5	11.50

	ADM	PROD
1	12.50	9.50
2	13.25	10.00
3	14.00	10.50
4	14.75	11.00
5	15.50	11.50
6	16.25	12.00
7	17.00	12.50
8		13.00
9		13.50

	ADM	PROD
1		
2		

Figure 4: This Lotus 1-2-3 worksheet produces the same results as those shown in Figure 3, but it uses a three-column lookup table and a second lookup table to furnish the column offset to use for each department.

only to change his or her entry in the DEPT column. The HRATE formula automatically gets the right value from the appropriate table.

Gilles Benjamin
Montreal, Quebec, Canada

► **PC MAGAZINE:** The @@ function is like a pointer in a formal programming language. The argument to this function should be a string that evaluates to a cell address (or a name assigned to a single cell). The cell specified in this argument should itself contain a string that evaluates to a cell or range address (or a name assigned to a cell or range). When evaluating the @@ function, 1-2-3 gets the value or values stored in the cell or range pointed to by the cell in the function's argument.

Thus, for example, if A1 contains

the string B2..B10, then @SUM(@@(A1)) is equivalent to @SUM(B2..B10).

The handy thing about using the @@ function, is that it makes it easy to supply varying input into a formula. If several formulas reference a range that may be subject to change, store the range address as a string in a cell and reference that cell via @@. When the range that all these formulas need to reference changes, you'll only need to edit the @@ function's target cell, not the contents of each individual formula.

Mr. Benjamin's assertion that @VLOOKUP only lets you get values from one table is not quite accurate, however. The third argument in the @VLOOKUP function specifies a column offset into the lookup table. An alternative way to set up the lookup values in Figure 3, therefore, would have been to create a three-column table in which the first column held the index values (1 through 9), the second held the ADM pay rates, and the third held the PROD pay rates. If this table had been named TABLE, then, the formula @VLOOKUP(E2,\$TABLE,1)

would get a value from the ADM column, while @VLOOKUP(E2,\$TABLE,2) would get one from the PROD column.

You could also use a second lookup table to supply @VLOOKUP with its third argument. For example, in Figure 4 there are two lookup tables. The first, Table 1, stores pay rates for the ADM and PROD departments. The second, Table 2, associates the strings "ADM" and "PROD" with values that can be used as column offsets into the first table. In the formula

```
@VLOOKUP(E2,$TABLE1,@VLOOKUP(D2,$TABLE2,1))
```

the second @VLOOKUP returns 1 or 2, depending on whether the value of D2 is ADM or PROD. This value then enables the first @VLOOKUP to return

the correct rate of pay.

Of the two approaches, Mr. Benjamin's is the simpler to read (once you get past the abstraction of the @@ function). But using variable column offsets into a single table may be preferable when the other approach would produce a large number of separate tables. For example, if you had 40 departments instead of 2, you might want to build a single lookup table for the pay rates and one additional lookup table to get the column offsets.

On the other hand, the multiple-column-lookup-table approach is entirely unsuitable when each column would require a different set of index values. In Mr. Benjamin's example, both the ADM and PROD tables use the same arithmetic series as index values (the PROD table goes up to 9, while ADM stops at 7, but this difference is immaterial). Had the index values differed significantly, the @@ technique would still work fine, while the many-column approach would not.—Craig Stinson

Databases

PRNTSCR() FUNCTION FOR CLIPPER PROGRAMS

✓ **TIP** One of the things that has annoyed me over the years is that the PrtSc key cannot be set to send a form-feed code after printing. If it could it would ensure that each screen prints on a new page.

To solve this, I wrote the Prntscr() function, shown in Figure 5, for use within my Clipper-based programs. Using Prntscr() is simple. You can call it from within an application to print the screen or use the SET KEY command to bind the function to a keystroke. For example, the command

```
SET KEY K_CTRL_F1 TO PRNTSCR
```

assigns the Prntscr() function to the Ctrl-F1 key combination. Note that you must include the following statement for K_CTRL_F1 to be defined:

```
#INCLUDE inkey.ch
```

The Prntscr() function works by first us-

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ing Clipper's **SAVE SCREEN** command to copy an image of the screen to a memory variable. It then accesses the contents of this memory variable using **SUBSTR**, taking advantage of the fact that every second character contains the attributes for each screen character.

Dale Shaw
Auckland, New Zealand

► **PC MAGAZINE:** Sending the screen to the printer under program control certainly ought to be a built-in feature. After all, it's the kind of thing that nearly everyone wants to do at one time or another, yet the only way to make it work flexibly and generically is to write custom code or .BIN files, or to use other assorted oddball techniques. Even though all PCs have a **PrtSc** key, they don't offer the option of sending a page eject after you hit the **PrtSc** key, and very few BIOSes (which are responsible for the **PrtSc** routine) correctly print anything other than ordinary 80-by-25 displays.

When you issue the command

SAVE SCREEN TO cScreen

Clipper saves a copy of the current screen image to the named memory variable cScreen. What's needed is a similar command, such as

SAVE SCREEN TO PRINTER

that would take a snapshot of the screen and then send it to the printer, taking care to note the current screen dimensions (which might not be 80-by-25) so that it sends line-feeds to the printer at the appropriate time.

But I digress (in the hope that the vendors are reading).

The screen image that Clipper saves is a snapshot of the video buffer as it exists at the time you issue the command. The video buffer is an area of memory where the ASCII values of the screen characters are stored, along with corresponding attribute values. Each character cell on the screen corresponds to one ASCII value and one attribute value.

The ASCII value represents the letter or symbol to display; for example, an A or a %. The attribute holds a bit pattern that tells the display hardware how to display the character. On a color system, it holds the foreground and background colors. On a monochrome system, it determines the character's intensity and whether it blinks or is displayed in reverse video.

On the typical 80-by-25 display there are 2,000 such cells, each corresponding to an ASCII value and an attribute byte, so the video buffer requires a total of

4,000 bytes. If you're using an enhanced video mode, such as 80-by-50, the corresponding memory requirements increase.

The video buffer stores character values and attribute values beginning with the upper-left corner of the display, at screen position 0,0 and then moving from left to right from the top of the display toward the bottom. That means the memory variable returned by `SAVE SCREEN` will start with the 2 bytes at screen position 0,0; followed by the 2 bytes at 0,1; followed by the 2 bytes at 0,2; and so on. The first byte in each pair (the even-numbered byte) is the character to display, the second (the odd-numbered byte) is the attribute.

Knowing the layout of the memory variable, you can then read the even-byte positions in order to determine the screen contents and write them to the printer or to a file. (At this point I should mention that you can modify the contents of the memory variable and then restore the screen from that variable using the `RESTORE FROM` command. This is the basis for many routines that perform special effects on the display by modifying the character or attribute bytes in the saved screen image and then restoring it to the display.) Mr. Shaw's `Prntscr()` function scans through the saved screen

PRTSCR.PRG

Complete Listing

[illegible][illegible]

Figure 5: You can use this Clipper function to send the screen image to the printer under program control.

image stored in the memory variable cScreen, pulling out each character byte and sending it to the printer. When the routine is finished printing the screen, it sends a form-feed to the printer.

I modified the function, which was originally hard-coded for 80-by-25 displays, so that it will work correctly with any display size. The routine first determines the maximum row using the MAXROW() function and the maximum column using the MAXCOL() function, then it adjusts its behavior accordingly. Note that if you use a display mode wider than 80 columns, you will probably need to set your printer to a suitable font before calling the Printscr() function. I added the ability to print an optional header or footer, and made the form-feed optional as well.

To call the function, you pass it the header, footer, and a logical value indicating whether to send a form-feed to the printer after printing the screen. For example,

```
Printscr("Sample Header",
"Sample Footer", .T.)
```

I mentioned above the need for a SAVE SCREEN TO PRINTER command. If you like, you can use Clipper's preprocessor to create your own SAVE SCREEN TO PRINTER command that calls the Printscr() function. Consider the following statement:

```
#command SAVE SCREEN TO
PRINTER [HEADER <header>]
[FOOTER <footer>]
{<formfeed: EJECT>}
=> printscr( <header>,
<footer>, <.formfeed.>.)
```

This creates a user-defined command called SAVE SCREEN TO PRINTER with optional HEADER and FOOTER clauses and an optional EJECT keyword. You can then replace calls to Printscr() with statements like this:

```
SAVE SCREEN TO PRINTER EJECT
```

OR

```
SAVE SCREEN TO PRINTER ;
HEADER "Print Screen"
```

Put the #command statement in a header file or at the top of your source file.

The code in Figure 5 can be found as PRTSCR.PRG on PC MagNet. Look in the Sol:Spreadsh/DBMS section of the Utilities/Tips Forum.—*Sal Ricciardi*

Graphics

GENERATING BULLETS IN PAGEMAKER

Is there an easy way to create good-looking bullet lists in PageMaker 4.0 without inserting each bullet character manually?

*Marc Groz
Brooklyn, New York*

► **PC MAGAZINE:** Here's the simplest answer to your question: Wait until Aldus releases PageMaker 5.0. This new version, which is due to ship in the first half of this year, will support automatic bullet and number lists in the form of an Aldus Addition.

For those who aren't familiar with Aldus Additions, this new technology allows Aldus, third-party developers, and even end users to extend PageMaker's capabilities. Think of an Addition as a utility program that can be invoked from within PageMaker. Indeed, in most cases an Addition appears to be a part of PageMaker and is accessible from PageMaker's drop-down menus.

PageMaker 5.0 promises to ship with 20 Additions in the box. These Additions will let you perform a variety of specialized tasks, such as customizing tracking tables, grouping multiple objects into a single item, and generating bulleted or numbered lists automatically. While the full retail price of PageMaker 5.0 will be \$895, the cost of upgrading is only \$150. You can get more information directly from Aldus by calling 206-622-5500 or 800-423-3173.

Until the new version ships, you'll have to use the following workaround that relies upon the search-and-replace func-

tions found in PageMaker's Story Editor. This technique takes advantage of PageMaker's ability to find and change text attributes as well as text characters. But be warned: While this trick can save you from the tedium of inserting bullet characters one by one, it can hardly be described as automatic.

Here's the process in a nutshell. When you create your text, either by using a word processor or by typing the copy directly into a PageMaker document, use a placeholder character for the bullet. I find that an asterisk works particularly well because it is a unique character that doesn't normally appear within words.

Now you can use PageMaker's Change command (located on the Edit menu within the Story Editor) to search for all of the asterisks and automatically change them to a bullet character.

Take a look at Figure 6. The topmost dialog box shows how easy it is to search and replace text style attributes (font, point size, and type style, for example). On the left, I've instructed PageMaker to find only those asterisks that have been formatted with a specific type style, which I defined previously as the Bullet style. On the right, I've told PageMaker to change the font (for that character only) to Wingdings, a TrueType font that consists of nothing but dingbats or decorative characters.

There are a few additional points to keep in mind. First, note that PageMaker cannot correctly display the bullet character in the Wingdings typeface in either the Story Editor or the Change dialog

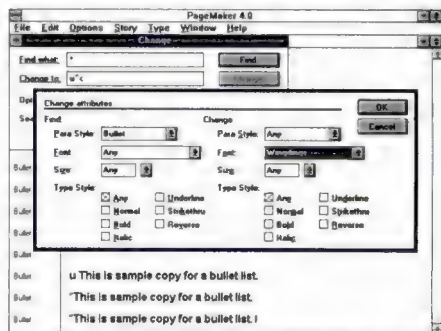


Figure 6: The Attributes dialog box, part of the Change function in PageMaker's Story Editor, allows you to quickly reformat text. Here a bullet character will be inserted into copy and automatically set in the Wingdings typeface.

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Graphics...Networking...Languages

box. As you can see in Figure 6, a lowercase *u* appears instead of a bullet. This isn't a bug—it's just that neither dialog boxes nor the Story Editor are intended to display formatting attributes. So instead of a WYSIWYG display of a bullet character, you see the letter that corresponds to that character. To see the formatting attributes on-screen you must be in layout mode.

This means you'll have to do a bit of research in order to designate the correct bullet character in the Change dialog box. You'll have to pick the bullet character you want and then figure out which keystroke it corresponds to. In this exam-

New PageMaker

Additions will let you perform a variety of specialized tasks, such as generating bulleted or numbered lists automatically.

ple, the lowercase *u* corresponds to a diamond-shaped bullet in the Wingdings typeface.

You must also pay attention to the spacing that surrounds bullet characters. It's often necessary to add some breathing room after a bullet character. Once again, you can make use of the Change dialog box to insert special nonprinting spacing characters. The backmost dialog box in Figure 6 shows that in addition to the actual bullet (indicated by the lowercase *u*), I'm adding a thin space (often referred to as a punctuation space). The caret symbol (^) tells PageMaker that the following character is a special symbol (like the copyright symbol, for example) or a nonprinting character (like an em-dash or thin space). In this case ^< inserts a thin space—the equivalent of one-quarter of an em-dash.

The advantage of this method may not be immediately apparent, but by using the Change dialog box in the Story Editor you can replace one character and assign

it a different type style without disturbing the rest of the paragraph formatting; all of the other attributes that are part of the defined style remain unchanged. In my example, I defined a style called Bullet, which is applied on a paragraph level and includes important formatting attributes such as a type style for the body copy, extra leading between items, and a hanging indent to accommodate the bullet character and the space that follows it. (The 12-point bullet and the thin space required an indent of 18 points.)

I admit that it takes some effort to work out all of these details. But you'll find that once you master this technique you can include decorative bullets in your lists without the hassle of inserting each bullet manually.—*Luisa Simone*

Networking

INSTALLING ETHERNET TERMINATORS

❓ I have a question about thick Ethernet cabling: When installing the terminators and the transceiver taps, do each of these items need to be exactly on the black distance markers, 8.2 feet apart? We're experiencing a lot of collisions and retransmits on our cable (we can see them on the transceiver's LEDs), and we don't know what's causing them. Our trunk is not over the 1,640-foot length limit, and it's not near any conductive motors or electronics.

*Jon Golberg
Offutt AFB, Nevada*

► **PC MAGAZINE:** The "frozen yellow garden hose" thick Ethernet cable (so-called because of its appearance and handling characteristics) has distance markers on the outside of the jacket to show the quarter-wavelength points. It's important to get the terminators installed exactly on the black marks at each end of the cable. Then when you tap into the cable at those points that are marked in between, the transceiver sees the correct impedance. If you miss a point by more than a few inches, theoretically at least, the impedance mismatch could set up reflections within the cable, causing the

type of problem you have described.

In practice, however, many users report that thick Ethernet works despite all types of mishandling. Rather than a problem with the backbone cable, I'd immediately suspect a bad adapter or a transceiver with the Signal Quality Error (SQE) switch turned on. SQE is an old feature that causes more problems than it solves. Installers quip that SQE has three letters just like OFF, so that tells you what to do with the switch. Thick Ethernet is difficult to install because of the size of the cable and the complex hardware involved in making every connection, but once it is in the walls it should work until the building falls down.—*Frank J. Derfler, Jr.*

Languages

RECURSION AND NUMERIC PARSING IN C

✓ **TIP** My EVAL program is a good example of how to use recursion in C. It is an expression evaluator that can compute almost any algebraic expression. I did not include support for trigonometric functions in EVAL. This program is handy when you need to compute a long expression and your calculator is out of reach. Simply type an expression at the prompt and read the results!

*Stan Finkler
Baltimore, Maryland*

► **PC MAGAZINE:** Mr. Finkler's program is not only a demonstration of recursion, it also illustrates how to properly parse a numeric expression. Using the program is simple, just type EVAL at the DOS command line. The program will print the allowable operations that can be included and will ask for the expression. After you enter the expression, the program returns a floating-point value or an error message.

The C source code for EVAL is shown in Figure 7. You can compile it with Microsoft C 6.0 or Borland C++ 3.0. Before discussing the recursive properties of the program, I'll briefly touch on how to parse a numeric expression.

I'll use the equation $x = 6 + 5 * 4 - 2$ as

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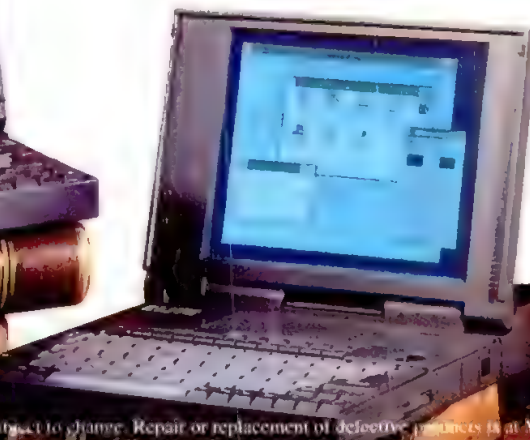
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SOLUTIONS

Languages

an example. Without parentheses to indicate the order of evaluation, the equation could be evaluated in a number of ways. If the expression is evaluated from left to right, the result is 42: $6+5*4-2 = 11*4-2 = 44-2 = 42$.

On the other hand, evaluating the expression from right to left gives $6+5*4-2 = 6+5*2 = 6+10 = 16$.

So which way is correct? Actually, neither.

The basic rules of arithmetic, the associative $(a+b)+c=a+(b+c)$, commutative $(a*b=b*a)$, and distributive $a*(b+c)=(a*b)+(a*c)$ laws govern how equations must be evaluated. These three laws, when they are applied to the standard arithmetic operations—addition, subtraction, multiplication, and division—will dictate the order in which the

operations should be performed.

When we apply the associative law to our example, we can swap the 6 and the -2 to write the equation in two equal forms like the following:

$$6 + 5 * 4 - 2 == -2 + 5 * 4 + 6$$

We should then be able to evaluate the two equal equations so that both return the same value. Evaluating both from left to right, we get

$$\begin{array}{rcl} 6 + 5 * 4 - 2 & == & -2 + 5 * 4 + 6 \\ 11 * 4 - 2 & != & 3 * 4 + 6 \\ 44 - 2 & != & 12 + 6 \\ 42 & != & 18 \end{array}$$

Evaluating both of the equations from right to left, we get

$$\begin{array}{rcl} 6 + 5 * 4 - 2 & == & -2 + 5 * 4 + 6 \\ 6 + 5 * 2 & != & -2 + 5 * 10 \\ 6 + 10 & != & -2 + 50 \\ 16 & != & 48 \end{array}$$

When we multiply first, we get

$$\begin{array}{rcl} 6 + 5 * 4 - 2 & == & -2 + 5 * 4 + 6 \\ 6 + 20 - 2 & == & -2 + 20 + 6 \\ 26 - 2 & == & 18 + 6 \\ 24 & == & 24 \end{array}$$

As you can clearly see, the only way these two equations will evaluate to the same number is when you perform the multiplication first. While this is certainly not a mathematical proof, it does effectively demonstrate the issue.

An easy way to remember the proper order of operations is the phrase "My

EVAL.C

1 of 2

```
.....
EXPRESSION EVALUATOR
.....
#include <stdio.h>
#include <math.h>

#define false 0
#define true 1

int NextChar;
int contin = true;

float Factor(void);
float Expression(void);
float Term(void);
.....
// GetNextChar - Reads characters until a non-space char is found
.....
void GetNextChar(void) {
    while ((NextChar = getchar()) == ' ');
}

.....
// Expression - A Recursive routine that evaluates an expression
// EXPRESSION = <EXPRESSION> + <TERM> | <EXPRESSION> - <TERM>
.....
float Expression(void) {
    float value;
    value = Term();

    for (;;) {
        switch (NextChar) {
            case '+':
                GetNextChar();
                break;
            case '*':
                GetNextChar();
                value = value * Term();
                continue;
            case '-':
                GetNextChar();
                value = value - Term();
                continue;
            default:
                return value;
        }
    }

    .....
// Term - Handles multiplication and division
// <TERM> = <TERM> * <FACTOR> | <TERM> DIV <FACTOR> | <FACTOR>
.....
float Term(void) {
    float value, divisor;
```

```
value = Factor();
for (;;) {
    switch (NextChar) {
        case ' ':
            GetNextChar();
            break;
        case '*':
            GetNextChar();
            value = value * Factor();
            continue;
        case '^':
            GetNextChar();
            value = pow(value, Factor());
            continue;
        case '/':
            GetNextChar();
            if ((divisor = Factor()) != 0) {
                value = value / divisor;
                continue;
            } else {
                printf (" DIVISION BY ZERO\n");
                exit(0);
            }
        default:
            return value;
    }
}

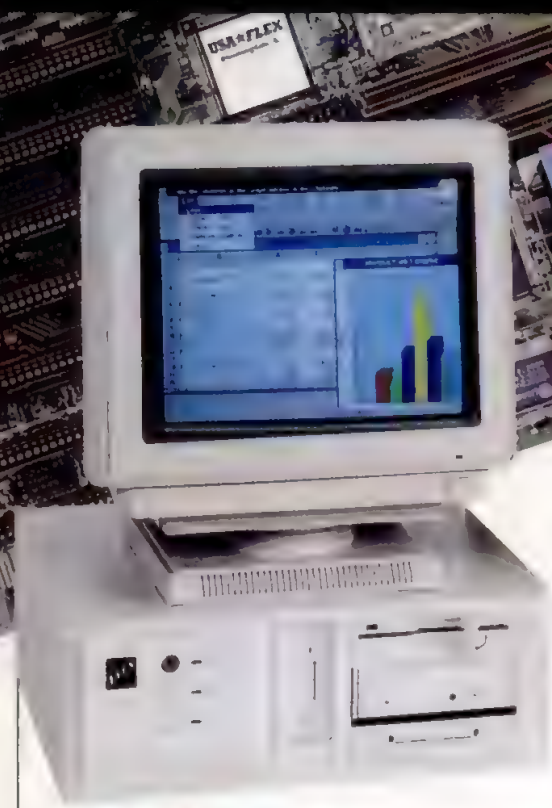
.....
// Factor - Handles numbers minus signs and parens
// <FACTOR> = <EXPRESSION> | <VARIABLE> | <CONSTANT>
.....
float Factor(void) {
    float value = 0;
    int count = 0;
    int i;
    int d_point = false;

    if ((NextChar <= '9') && (NextChar >= '0')) {
        while ((NextChar <= '9') && (NextChar >= '0')) {
            value = value * 10 + NextChar - '0';
            NextChar = getchar();
            if (d_point)
                count++;
            if (NextChar == '.') {
                NextChar = getchar();
                d_point = true;
            }
        }
        for (i = 0; i < count; i++)
            value = value / 10;
        return value;
    } else {
        switch (NextChar) {
            case '-':
```



Figure 7: The C source listing for the EVAL program, which uses recursive functions to perform arithmetic on the command line.

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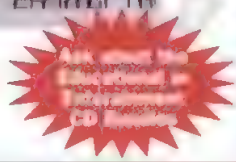
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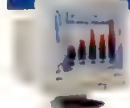
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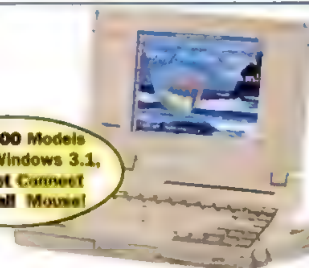
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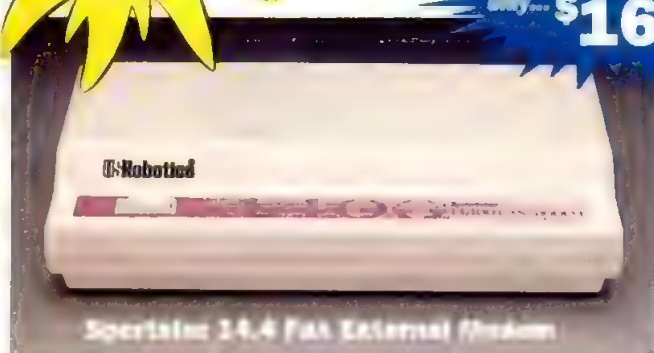
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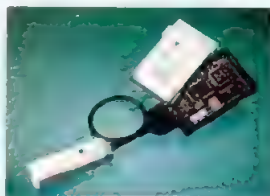


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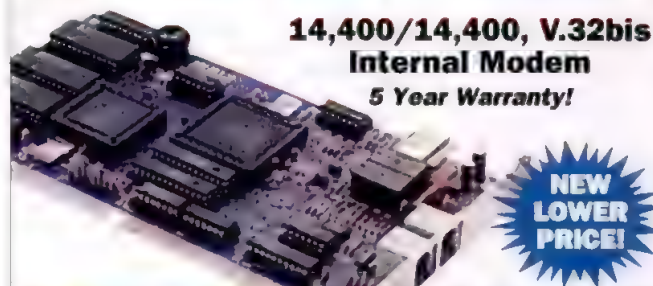
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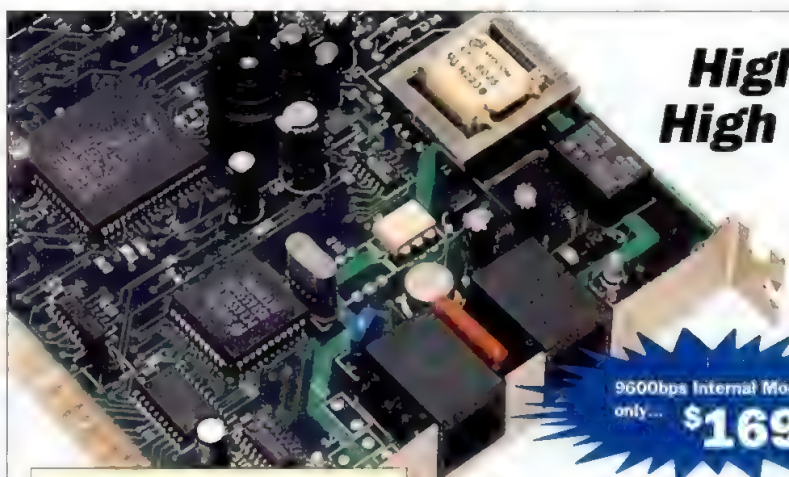
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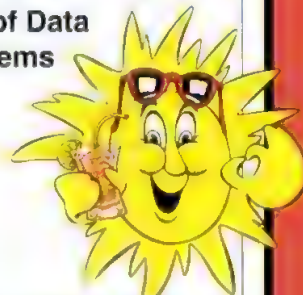


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Code # PM06B3

EVAL.C

2 of 2

```

    GetNextChar();
    return -1*Factor();
case '(':
    GetNextChar();
    value = Expression();
    if (NextChar != ')') {
        printf (" MISMATCHED PARENTHESES\n");
        exit(0);
    } else
        NextChar = getchar();
    return value;
case '-':
    d_point = true;
    default:
        contin = false;
}
}
return 0;
}

```

```

//*****
// Main - Program entry point
//*****

```

```

void main () {
    float result;

    printf ("\nExpression must not contain any other symbols but:\n");
    printf ("\n+ addition\n- subtraction\n* multiplication\n/ division\n^ - left parenthesis\n' - right parenthesis\n.");
    printf ("\n." decimal point (must be preceded by digit)\n");
    printf ("\n^ - x^y means x to the power of y\n");
    printf ("\nEnter expression: ");

    GetNextChar ();
    result = Expression();

    if ((NextChar == '\n') && (contin))
        printf ("THE RESULT IS: %.3f\n", result);
    else {
        printf (" SYNTAX ERROR\n");
        exit(0);
    }
}

```

Dear Aunt Sally." The first letters of each of the words stand for *multiplication*, *division*, *addition*, and *subtraction*, in the correct order of precedence.

In practice, multiplication and division have the same precedence, higher than addition and subtraction. So, for the original equation, $x=6+5*4-2$, 5 must be multiplied by 4 in order to get 20, then the 6 can be added and the 2 subtracted to yield 24.

The use of parentheses overrides the standard precedence. Operations enclosed in parentheses are evaluated before other operations. So if the routine had been written $x=6+5*(4-2)$, x would be 16, since the 4-2 would be evaluated before the multiplication.

The difficulty in writing an equation evaluator is that the program needs to know the next operator in order to know whether to perform the current operation. In our example a program cannot know whether it can perform the addition without first checking the operator located to the right of the 5. In this particular equation, the addition must be delayed until the multiplication is performed. If an operator with even higher precedence than multiplication were to the right of the 4, the multiplication would also have to be delayed until that operation was performed.

Now that we know the rules, it's time to take a look at Mr. Finkler's program. It uses three subroutines to explicitly set the operator precedence. The Factor routine handles converting individual digit characters into numbers, the Term rou-

tine handles multiplication and division, and the Expression routine handles addition and subtraction. In the case of the Expression routine, an addition is not performed until the Term routine is called to determine whether the next operation is multiplication or division. Term in turn calls Factor to return the next character in the expression, which may or may not be a number.

The program starts by printing a list of the allowable operations and a prompt to the user. It then initializes the variable CurrChar with the first character entered, and the Expression procedure is called. The Expression routine first calls Term, which in turn calls the Factor routine. Factor checks to see if the character is a digit, decimal point, minus sign, or opening parenthesis. If the character is a number, Factor continues to read characters until a nondigit is found and then returns the value of the digits. If the first character is a minus sign, Factor calls itself and multiplies the result by -1. This is one of the places in the program where recursion is used.

Recursion is a technique where a procedure calls itself to perform its function. In the case of a leading minus sign, the Factor function must still process whatever follows the minus sign. This part of Factor could have been written to explicitly look for a number following the minus sign, but then it would have also had to look for parentheses—which was already a function of the Factor routine! Instead of having duplicate functions inside the routine, the Factor routine sim-

ply calls itself to process the characters past the minus sign. The returned value from the recursive call is then multiplied by -1 in order to change the value's sign, and the initial call to Factor returns.

It is conceivable for a series of leading minus signs to cause Factor to recurse a number of times. The only limitation to this process (aside from the 128-character input line) is the stack space needed for each of the calls. When writing a recursive routine, you should ensure that the program has enough stack space to handle the maximum number of recursive calls that may occur. The EVAL program has no explicit checking of recursion depth, but for this simple example, that shouldn't cause a problem.

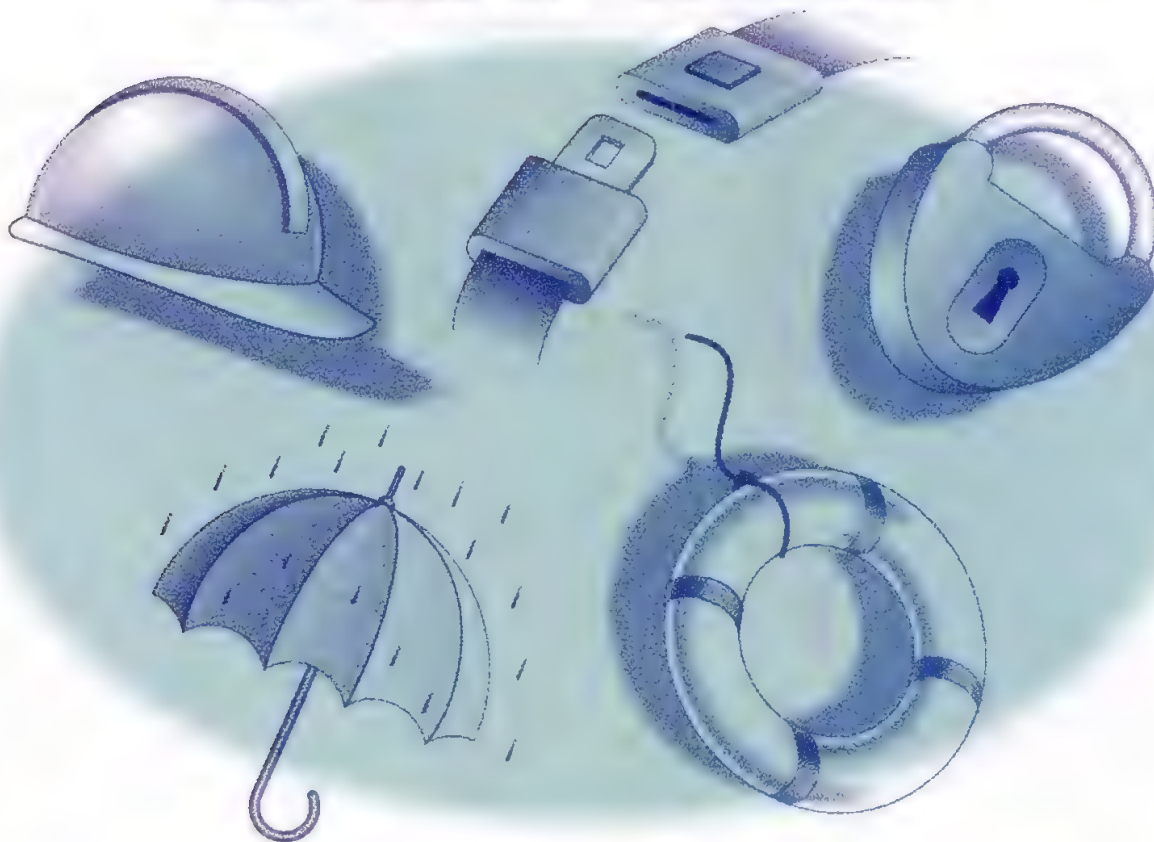
Another interesting use of recursion can be seen where the Factor routine processes an open parenthesis. In this case the expression inside the parenthesis must be completely evaluated before performing the operation to the left of the parenthesis. Term calls the Expression routine to completely evaluate the enclosed expression. After the call to Expression returns, the open parenthesis routine ensures the proper syntax by checking for the closing parenthesis.

Recursive routines can look confusing at first, but when you use them with care, they can greatly simplify a program. In EVAL, recursion proves to be just the right key to solving the problem!

You can download EVAL from the Programming Forum on PC MagNet, archived as EVAL.ZIP.

—Douglas Boling □

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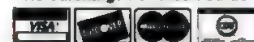
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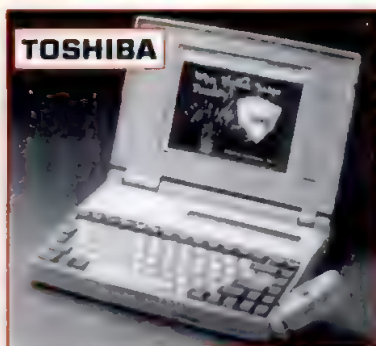
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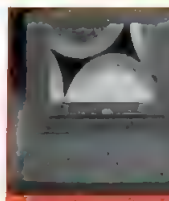
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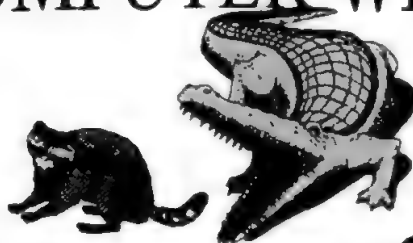
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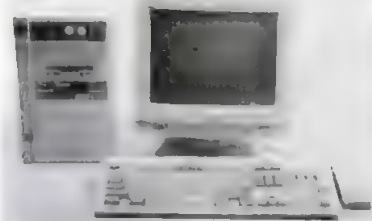
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- Graphics Card
- 101 Keyboard
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486 DX-33 Mhz

COMPUTER

- Medium Tower Case
- 128K Cache
- 4 MEG RAM Memory
- 1.2 Floppy Drive
- 1.44 Floppy Drive
- 80 MEG IDE Hard Drive
- 1 MEG Graphics Card
- 101 Keyboard
- 14" SVGA Monitor
- Mouse
- 200 W Power Supply

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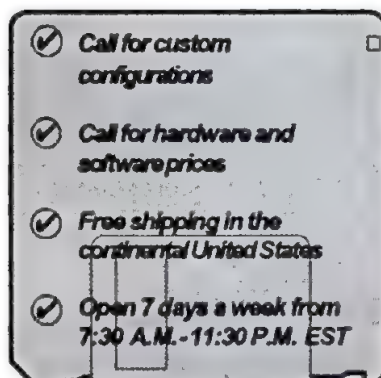


486 DX2-50 Mhz

COMPUTER

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- 128K Cache
- 4 MEG RAM Memory
- 1.2 Floppy Drive
- 1.44 Floppy Drive
- 80 MEG IDE Hard Drive
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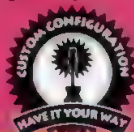
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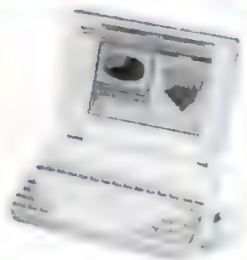
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- MS-DOS, Windows 3.1

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486SX25	4MB	80MB	\$1639
486SX25	4MB	80MB	\$1639
486SX25	4MB	80MB	\$1639
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Contura 3/25

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Display	Hard drive	Price
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Color	120MB	\$2149

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PowerExec

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- Windows 3.1

Screen	Model	Price
8086SX25 Mono	8086SX25	\$2009
8086SX25 Mono	8086SX25	\$2019
8086SX25 Active Color	8086SX25	\$2019
8086SX25 Mono	8086SX25	\$2019
8086SX25 Active Color	8086SX25	\$2019

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TOSHIBA

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- PCMCIA slot
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- MS-DOS, Windows, Trackball

Processor	Hard drive	Price
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8086SX25 Color	80MB	\$2249

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- Smoothscan color VGA Activeplex
- Microsoft Roundpoint trackball
- MS-DOS, Windows 3.1

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486SX25	4MB	80MB	\$2599

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\$2599

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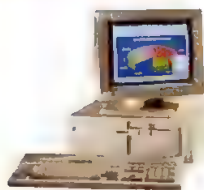
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- MS-Productivity, Quicken for Windows

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486SX/33	213MB	\$1169
486DX/33	130MB	\$1259
486DX/33	245MB	\$1369
486DX2/66	245MB	\$1749

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- Local bus slot, 1MB video RAM

Processor	Hard Drive	Price
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SX33	130MB	\$1199
DX33	130MB	\$1379
DX33	213MB	\$1459
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DX2/66	213MB	\$1789

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- Mouse

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486DX33	170MB	\$1499

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4/66d		\$2269

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- QVision graphics controller
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- MS-DOS, Windows 3.1, mouse

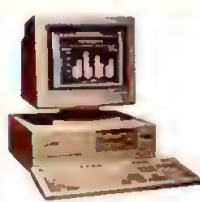
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- 4 32bit EISA expansion slots
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486DX33	4MB	\$2409
486DX2/66	8MB	\$3799

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Processor	Drive	Price
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4/33	170MB	\$2579
4/66d	340MB	\$3329

AST SVGA color monitor \$429.99

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\$2199



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Processor	RAM/Drive	Model	Price
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Mono	160MB	\$2999
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- Built-in trackball

Screen	Hard drive	Price
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Active matrix color	84MB	\$2999
Active matrix color	120MB	\$3459

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Processor	Hard Drive	Price
486DX2/50 plasma	200MB	\$3699
486DX2 50 color	200MB	\$5749

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\$3699



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ValuePoint II 486

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- MS-DOS, Windows, mouse

Processor	Hard drive	Bays/slots
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SX25	245MB	3/3
SX25	245MB	5/5
DX33	120MB	3/3
DX33	245MB	3/3

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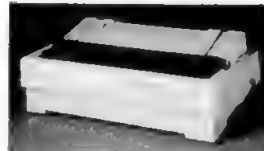
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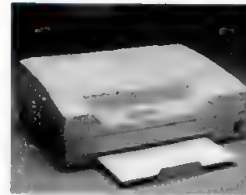
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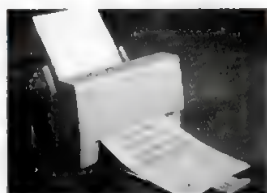
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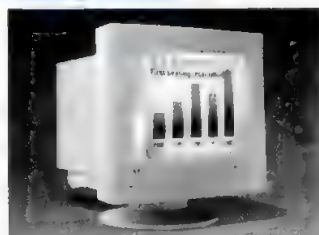
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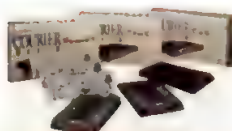
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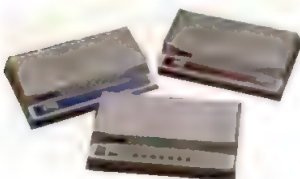
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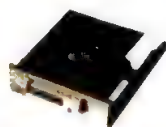
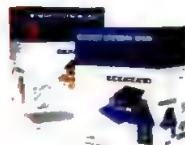
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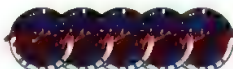
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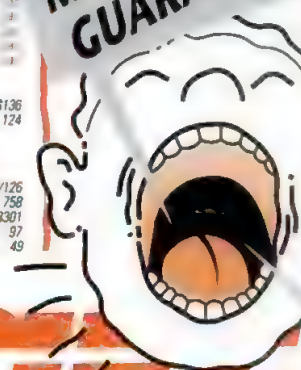
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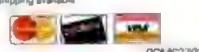
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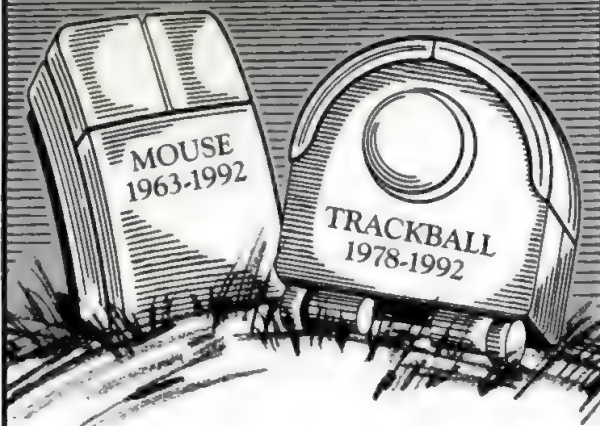
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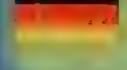


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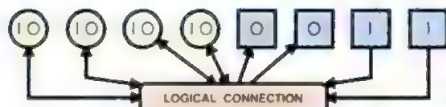
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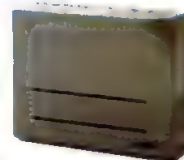
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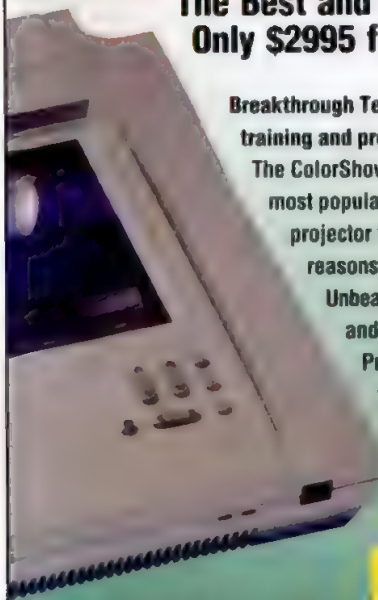
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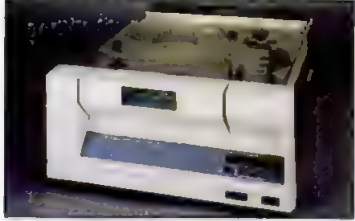
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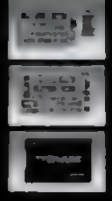
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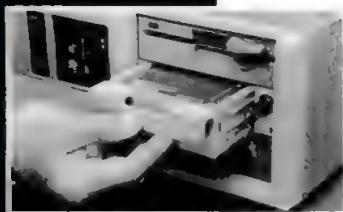
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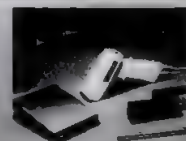
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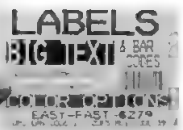
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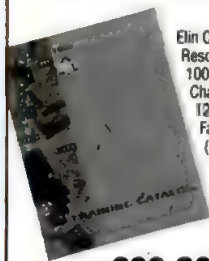
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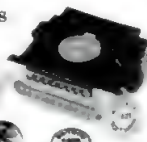
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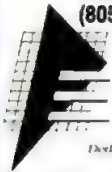
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Or use direct dial 64 Line BBS at (503) 697-5100 8/N/1

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3D ★ STUDIO MOVIES
SOUND ★ GAMES
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Event Horizons Commercial BBS, thousands of images and movies. Must be 21 to download from adult areas. Quality Color SuperVGA/EGA. 1200/2400 bps \$12/hr., 9600 bps \$48 hr., 800# \$6/hr. extra. Also Professional Image Scanning from prints or slides to disk.

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800-466-6336, or BBS
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1. Fill in your name and address and check off your answers to the nine research questions.

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3. The literature will be mailed to you from the advertiser free of charge.

CIRCLE FOR FREE INFORMATION

Valid after October 31, 1993

001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036	037	038	039	040	041	042	043	044	045	046	047	048	049	050
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1. Do you work in a DP/MIS dept.?
01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity: (Check one)

01. ☐ Manufacturer Computer Equip., Computers, Software
02. ☐ Manufacturer—Aerospace
03. ☐ Manufacturer—Other
04. ☐ Systems House
05. ☐ Computer Consultant
06. ☐ Computer Retailer/VAR/VAD Distributor
07. ☐ Communications
08. ☐ Finance/Banking/Insurance/Real Estate/Accounting
09. ☐ Education
10. ☐ Government
11. ☐ Research and Development
12. ☐ Data Processing/Computer Service
13. ☐ Health/Medical/Legal Service
14. ☐ Engineering/Architecture

16. ☐ Agr./Const./Mining/Oil/Transp./Utilities17. ☐ Non-Computer Retailer/Dist.18. ☐ Other Business or Service

3. Please indicate your primary business function: (Check one)

01. ☐ DP/MIS
02. ☐ Systems, Programming
03. ☐ Communications
04. ☐ Engineering
05. ☐ Res./Dev./Scientific
06. ☐ Accounting/Finance
07. ☐ Computer Consulting
08. ☐ Purchasing
09. ☐ Operations
10. ☐ Production
11. ☐ Education/Training
12. ☐ Marketing/Sales
13. ☐ Medical/Legal
14. ☐ Admin./Mgmt.

4. Is your company a reseller?

01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

01. ☐ 10 or less 03. ☐ 26-9902. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC products?

01. ☐ Now 03. ☐ In 7 to 12 months02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

01. ☐ 25 or less 03. ☐ 100-499 05. ☐ 1000 or more02. ☐ 26-99 04. ☐ 500-999

Name

PC 6/29-5

Title

Telephone

Company Name

Address

City

State

Zip

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2 Circle the numbers on the card that correspond to the ads or articles you'd like more information about

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Valid after October 31, 1993

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- Do you work in a DP/MS dept.?
 - Yes
 - No
- Please indicate your company or organization's primary business activity: (Check one)
 - Manufacturer Computer Equip., Computers, Software
 - Manufacturer-Aerospace
 - Manufacturer-Other
 - Systems House
 - Computer Consultant
 - Computer Reseller/VAR/VAD Distributor
 - Communications
 - Finance/Banking/Insurance/Real Estate/Accounting
 - Education
 - Government
 - Research and Development
 - Data Processing/Computer Service
 - Health/Medical/Legal Service
 - Engineering/Architecture
- Please indicate your primary business function: (Check one)
 - DP/MS
 - Systems, Programming
 - Communications
 - Engineering
 - Res./Dev./Scientific
 - Accounting/Finance
 - Computer Consulting
 - Purchasing
 - Operations
 - Production
 - Education/Training
 - Marketing/Sales
 - Medical/Legal
 - Admin./Mgmt.
- For how many IBM PCs and compatibles do you specify brands of products?
 - 10 or less
 - 25-99
 - 100 or more
- Are there any PCs in your office?
 - Linked to mainframe
 - Linked to mini
 - Networked together
- Please check the equipment currently installed at your location: (Check all that apply)
 - IBM or Compatible PCs
 - IBM or Compatible Mainframes
 - IBM or Compatible Minis
 - Macintosh
 - CD-ROM
 - Windows
- Do you plan to buy any PC products?
 - Now
 - In 7 to 12 months
 - In 4 to 6 months
 - No definite plans
- Number of employees in your entire company:
 - 25 or less
 - 100-499
 - 500-999
 - 1000 or more
- Is your company a reseller?
 - Yes
 - No

Name _____ PC 5/29-5

Title _____ Telephone _____

Company Name _____

Address _____

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Is a Harry? Fax This Card To: 609-764-7157

PC Magazine's BusinessCard section is a forum for innovative, hard to find and low cost PC products and services. Ads are listed by product category and include Reader Service numbers to allow fast, easy response.

RATES:

1 issue-\$7.15, 3 issues-\$625, 6 issues-\$605,
12 issues-\$570, 17 issues-\$545, 22 issues-\$535.
Multiple ad per issue rates also available. Prepayment must accompany each insertion. VISA/MC welcomed.

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PC Magazine will design and typeset each BusinessCard ad. Advertisers should furnish typewritten copy. Ads include: 1) Headline (1 line, initial caps=30 characters max, all caps=25 characters max). 2) Descriptive copy (5 lines, 225 characters max). 3) Company name (same specifications as headline) and 4) Address and telephone number (2 lines, 40 characters per line). No logos, artwork or camera-ready ads. Publisher reserves the right to edit supplied copy to meet section specifications.

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PC Magazine is published 22 times a year, bi-monthly except for July and August. The BusinessCard closing is approximately two months prior to issue date.

Please send copy and payment to:
PC Magazine BusinessCard
One Park Avenue, 3rd Floor
New York, NY 10016

For more information, call 800-825-4237 or 212-503-5115. FAX: 212-503-5860.

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CIRCLE 656 ON READER SERVICE CARD

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WHOLESALE 486 PRICING

486SX 25:\$1199, 486DX 33:\$1339, 486DX2-50:
\$1469, 486DX-50: \$1509, 486DX2-66: \$1589
4MB RAM, 1.2 & 1.4FD, 170MB HD, SVGA .28,
KB101, SVGA w/1M, 2S1P1G, Mouse 1 Yr. Wnty.
OPT CD ROM \$195. VESA LOCAL BUS AVAILABLE!

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Western Digital, 340 MEG, 12MS, 3 yr wnty \$430
CALL FOR CURRENT PRICES! LOWEST Guaranteed!

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CIRCLE 663 ON READER SERVICE CARD

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- Almost 1000 SVGA adult images
- 100% Free of Copyright hassles!

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800-GIFFY69/619-624-0375/FAX: 619-528-1080

CIRCLE 664 ON READER SERVICE CARD

CD-ROM WAREHOUSE

NIGHT OWL 8 - \$54.95, Kings Quest V - \$29.95
WINDOWS 1993 - \$39.95, US Atlas w/Automap -
just \$39.95!!! Mayo Clinic Health Book - \$49.95
see article in May 11th issue pg.454! 100's of other
titles available! FREE Catalog! V/MC/AmEx.

CD-ROM WAREHOUSE

1355 W. Palmetto Pk Rd. Ste 348, Boca Raton,
FL 33486. Tel: 800-344-2599.

CIRCLE 665 ON READER SERVICE CARD

WALNUT CREEK CDROM

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Coming Up

THE PERFECT PC '93

How do you pick the perfect PC? No one model or setup suits everybody. In our cover story, our editors walk you through the decision process to help you choose the machine that is right for you. You learn how to fit the individual components and accessories together to produce the ultimate dream machine, the best Windows workstation, the ideal small office system, and the most appropriate network server. And you also learn the best ways of upgrading your existing system.

The Perfect Hard Disk helps you choose between IDE, SCSI, and ESDI at the right storage capacity. We also cover the intricacies of upgrading your hard drive and the quality of service and support you can expect when you order from a mail-order house or reseller.

The Perfect Display addresses the new emphasis on display technology brought about by Windows and graphical applications. We examine different monitors and graphics cards and offer guidelines for choosing the ones that are best for you.

The Perfect Accessories rounds out our special feature with a look at mice, keyboards, sound boards and other devices.

DIAGNOSTIC SOFTWARE

Your PC may be the smartest piece of equipment in your office, but it needs a little help when it comes to recognizing what's inside of it and how well it's all working together. In our next issue, *PC Magazine* will look at some of the top diagnostics tools and pick the best of the bunch.

CABLE TESTERS

Most LAN problems are ascribable to a fault or failure in one or more of the cables connecting the enterprise, but tracking down *which* cable and *what* the problem is can make LAN managers old before their time. *PC Magazine* reviews cable testing units from John Fluke Manufacturing, Microtest, Scope Communications, and Wavetek. They just may preserve your youth.

FREE UTILITY

In the next issue we'll present FIND, a Windows 3.1 text-search utility that lists all occurrences of a string. You can use FIND to scan a single file, a set of files, or an entire partition. However, the best part about FIND is how it works: It seamlessly integrates itself into the Windows File Manager, simply appearing as an additional item on the File Manager menu. □

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After Hours

MUSIC: Music Mentor; Jazz: A Multimedia History; Musical Instruments; The World of Music Sampler

MUSIC

Software for Audiophiles: Four Music Appreciation Packages

BY ROBERT KENDALL

A music enthusiast and a multimedia PC can be a perfect combination. A good sound card and a CD-ROM drive provide an ideal environment for learning about music; add a Musical Instrument Digital Interface (MIDI) synthesizer, and you can have an entire musical experience at your fingertips as you read about it, making learning much more direct and meaningful.

Here are four packages that will satisfy almost any music lover. Musical Instruments, from Microsoft, and Jazz: A Multimedia History, from Compton's New Media—both CD-ROMs—turn reference works into interactive explorations replete with audio and graphics. The Compton's title even throws in motion video.

Midisoft takes an alternative approach, offering an introduction to music history and theory with MIDI samples. Midisoft's Music Mentor with Recording Session for Windows doesn't require a CD-ROM drive, but demands a good MIDI synthesizer. The company's The World of Music Sampler is a collection of MIDI files of music in various styles that can be enjoyed and studied by anyone with a sequencer program.

MIDISOFT CORP.

Music Mentor

MIDI is not only a terrific music-making tool; it can also be a great learning aid. Midisoft's Music Mentor with Recording Session for Windows gives an excellent introduction to the history and theory of classical music, and includes a simple sequencer for working with the package's generous selection of classical music in MIDI file format.

Music Mentor provides background on important composers and musical styles and lets you listen to samples of the classics. Since all the samples are in the form of MIDI files, you'll need a high-quality synthesizer to get the most out of this program—preferably one that uses wave-table lookup and samples of actual instrument sounds. An inexpensive FM synthesizer board will give an inaccurate representation of the music and limit the program's instructional value.

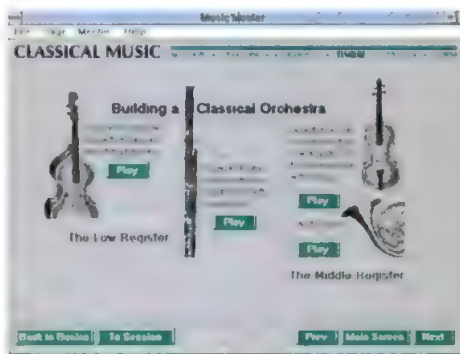
MUSICAL BASICS

Music Mentor's main screen lets you select a lesson in musical basics or choose a historical period to explore. The basics section covers six fundamental concepts of music: melody,

rhythm, harmony, timbre, texture, and form. Within the history section, Music Mentor describes how composers used those elements during the early, baroque, classical, romantic, or modern music periods. A separate series of lessons provides the fundamentals of musical notation.

You navigate each lesson screen by clicking on the Next or Previous buttons, while Play buttons launch the musical examples.

Music Mentor does its best



Build your own: Music Mentor teaches basic musical principals in an interactive style.

to make learning fun. The text is spiced with humor (though its jokes occasionally wear thin), and the program uses interactive elements imaginatively. A lesson on program music, for example, plays sections of Smetana's "The Moldau," asks you to match those sections to their programmatic descriptions, and keeps score of your results. This music quiz effectively demonstrates music's scene-painting powers.

Despite the inevitable oversimplifications and a few inaccuracies concerning Renaissance dances, Music Men-

tor makes a respectable music history teacher. The tutorial on music notation isn't comprehensive enough to impart a full working knowledge to beginners, but it makes a good start.

SCALED-DOWN SEQUENCER

As a bonus, Music Mentor includes Recording Session, a scaled-down version of the Midisoft Studio for Windows sequencer. Recording Session provides the basics of MIDI file editing and recording and

features an attractive interface, but lacks, among other things, printing capabilities.

The two programs are closely integrated: If you open Recording Session from Music Mentor, for instance, you'll find the last musical example that you heard loaded into the sequencer.

Recording Session uses conventional staff

notation for displaying sequences, rather than piano-roll graphical display. It will render any Standard MIDI file into notation, including the Music Mentor musical examples and the additional classical selections included in MIDI file format.

When you play these files, the staves scroll to follow the music, and each note is highlighted in green as it sounds. Unfortunately, the notation screen is often very inaccurate, especially if triplets or short note durations are involved.

Still, the interface makes

Music Mentor

Recording Session quite easy to use. Mouse-controlled graphical faders and knobs let you adjust volume, panning (the placement of sounds in the stereosound field), reverb, and other effects for each track. You can record from a MIDI keyboard, edit music by placing notes on the staff with the mouse, or cut and paste sections. An event list editor lets you work with some of MIDI's more arcane elements—such as continuous controllers—for gaining finer control over musical nuances.

Music Mentor has a lot to teach the curious beginner. It

combines an imaginative approach with a sensible, varied selection of musical samples. Despite the limitations of Recording Session's music notation screen, this program provides a useful adjunct to Music Mentor, offering easy entrée into working with MIDI files.

Music Mentor with Recording Session for Windows, \$149.95. Requires: 4MB RAM, 5.5MB hard disk space, Windows 3.0 or later, MIDI interface and synthesizer. Midisoft Corp., P.O. Box 1000, Bellevue, WA 98009; 800-776-6434, 206-881-7176; fax, 206-883-1368.

Circle 456 on reader service card

COMPTON'S NEW MEDIA

Jazz: A Multimedia History

If you want a deeper appreciation of those jazz recordings that have accumulated on your shelves, pick up a copy of *Jazz: A Multimedia History*. Compton's New Media's CD-ROM sheds light on the music and the musicians, letting you explore the jazz world with the aid of extensive text, audio and video examples, as well as photos.

Jazz: A Multimedia History succeeds largely because of its content, rather than its use of the CD medium. The disk contains the full text of

the excellent book *Jazz: From Its Origins to the Present* (Prentice-Hall, 1993), by Lewis Porter, Michael Ullman, and Ed Hazell. Its 24 chapters provide an exhaustive examination of jazz in all its forms, from its earliest stirrings to the 1990s.

The well-researched text is clearly the work of authoritative authors, yet it is always engaging. Frequent quotes from the musicians themselves enliven the discussions. The text traces the beginnings of jazz from various musical styles in New Orleans and includes discussion of the changing attitudes toward the art form.

■ The World of Music

Collections of Standard MIDI files on disk have become quite common, but Midisoft's *The World of Music Sampler* offers some of the highest-quality classical music sequences available for the PC. This disk contains one or two sequences from each of 15 volumes that Midisoft is considering for an upcoming MIDI file library called *A World of Music*. It also includes samples from the sequences included with Music Mentor and from The Midisoft Multimedia Library of production music.

About half of the 37 selections are classical music, including some large orchestral works. You get complete movements from Bach's *Brandenburg Concerto No. 6* and Grieg's *Peer Gynt Suite I*, long excerpts from Mozart's *Jupiter Symphony* and Haydn's *Surprise Symphony*, and a few keyboard pieces by Bach, Mozart, Debussy, and Scott Joplin, too.

Midisoft has also included some original jazz and pop tunes, with renditions of both "Rock-a-Bye Baby" and "God Save the Queen" thrown in for good measure.

If you want to create your own jazz or rock sequences, you can use a selection of drum tracks that's offered in different styles that you can paste into your own work.

Each sequence comes in two versions—one for high-end General



The World of Music Sampler: High-quality MIDI samples for music lovers.

MIDI synthesizers and one for the low-end FM synthesizers built into MPC sound boards. The music leaves much to be desired when played back on an FM device, but on the powerful Roland

Sound Canvas, the orchestral pieces sound close to the real thing.

The playing isn't always perfect, but it's consistently top-notch, with careful attention being paid to dynamics. All the rubatos and other expressive tempo inflections of a live performance are retained, but the program uses a tempo track, so beats line up properly with the bar lines when you work with the pieces in a sequencer. Unlike most MIDI clips, these sequences also make good use of panning, reverb, chorus, and other continuous controllers to add realism to their sound.

Besides portending an upcoming library that MIDI enthusiasts will love, Midisoft's *The World of Music Sampler* provides a rich source of music that may be used in presentations, royalty-free. This collection is one that every music lover should own. □

The World of Music Sampler, \$24.95. Requires: 2MB hard disk space, MIDI sequencer, MIDI synthesizer or sound card. Midisoft Corp., P.O. Box 1000, Bellevue, WA 98009; 800-776-6434, 206-881-7176; fax, 206-883-1368. Circle 459 on reader service card

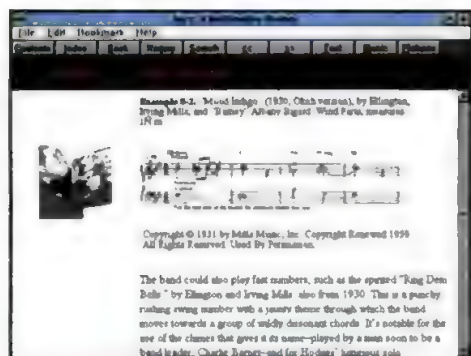
Jazz: A Multimedia History

There are entire chapters devoted to Armstrong, Ellington, Basie, Parker, and other leading lights.

The attentive reader will learn a great deal about the personalities, careers, and music of both major figures and lesser-known musicians. The text admirably elucidates the confusing profusion of different jazz styles, including swing, bebop, cool, fusion, and free jazz.

A bibliography, a discogra-

phic, a glossary, and a first-rate text-search engine complement the text. A teacher's manual is available free from the publisher, reflecting the program's pedagogical aims.



Look and listen: A recording of a selection from Ellington's "Mood Indigo" accompanies this text.

phy, a glossary, and a first-rate text-search engine complement the text. A teacher's manual is available free from the publisher, reflecting the program's pedagogical aims.

DISAPPOINTING AUDIO

Unfortunately, *Jazz: A Multimedia History* fails to tap CD-ROM's full potential. Gray-scale photos dot the text, and the examples in musical notation help clarify the detailed discussions, but these notations are often blurry and hard to read.

The audio clips you play by clicking on the musical notation should be the program's highlight, but they're actually a disappointment. In most cases, instead of hearing the wailing horns of the masters themselves, you hear a synthe-

sizer recreating one or two of the instrumental parts in the original recording. Only a few musical samples in *Jazz: A Multimedia History* are the real thing.

The music is offered in the form of audio CD tracks, 8-bit .WAV files, and MIDI files, but when you click on a notated musical example, it's the .WAV files you hear rather than higher-quality CD audio.

Jazz: A Multimedia History also uses six video clips, in Video for Windows format, that let you see and hear legendary performers, such as Louis Armstrong, Duke Ellington, Miles Davis, and Charlie Parker.

Just as you'd expect with this format, the images are minuscule and grainy, and motion is often very jerky, even on a 66-MHz, 486DX2

local-bus machine.

The program would also benefit from hypertext links and graphical timelines. Anyone looking for a quick and simple introduction may find this package too much to absorb. The musical analyses may be over their heads as well, since they presuppose a certain degree of musical knowledge. Real jazz lovers, however, will find themselves turning to the program again and again.

Jazz: A Multimedia History, \$99.95 Requires: 4MB RAM, Windows 3.1, CD-ROM drive, sound card. Compton's New Media, 2320 Camino Vida Roble, Carlsbad, CA 92009; 800-862-2206, 619-929-2500; fax, 619-929-2511.

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Musical Instruments

Microsoft's *Musical Instruments* may help make printed reference works obsolete. This multimedia CD-ROM title unfolds the riches of more than 200 musical instruments from many diverse cultures. You'll find everything from the ancient bullroarer to the digital sampler presented with photos, illustrations, and audio examples via an attractive, if somewhat icon-happy, interface.

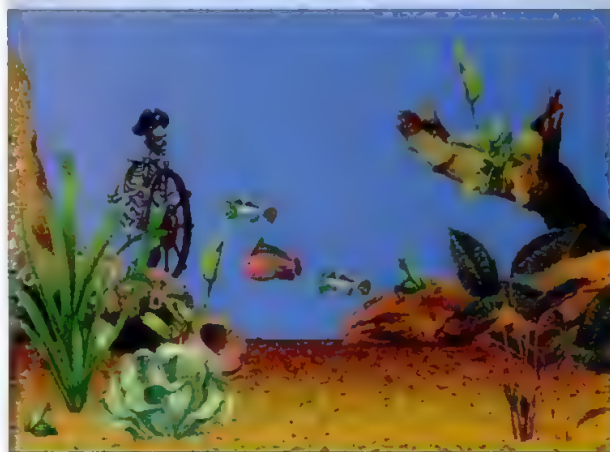
The program lets you access its wealth of information from many different angles. You can look up instruments by geographic

origin, by family (brass, strings, and so on), by the type of ensemble they're used in, or alphabetically. Of the four, the most appealing is by way of a world map that lets you zoom in on various locales and their musical instruments.

The entry for each instrument includes a 256-color photo and various textual annotations describing the instrument and its use. Each part of the instrument is labeled and explained, and you can often click on the labels or illustrations, for a close-up of a pegbox or strings, for example. Other icons provide illustrations of the instruments from different angles or of traditional players of the

Muzak for the Eyes:

Relax with Maxis's *El-Fish*



EL-FISH NEVER DIE. With *El-Fish*, you can catch, breed, genetically engineer, and animate your own electronic fish, then design and stock your own aquarium using a library of more than 250 objects and backgrounds. As in real life, a tranquil pleasure comes from watching these colorful, graceful swimmers. You can feed your el-fish as much as you want, and the tank will never need cleaning. One warning: Fishing demands patience, but el-fishing demands patience and resources. Catching or creating an el-fish takes as long as 5 minutes; animating it ties up a 25-MHz 386 without a coprocessor for four hours. On a 486DX, animation takes about 10 minutes. If you have a sound card, you can also generate music for your tank in styles from new age to hip-hop. (Maxis, 510-254-9700.)

instruments; a Facts icon pops up some mundane technical details, such as its size, the materials used in its construction, and its pitch range.

Most important, Musical Instruments lets you hear the music. Click on a sound icon to hear a brief sample, or call up the instrument's screen of details to find additional icons that provide more extended audio samples of the instrument in action. Still other icons let you hear alternative styles of playing, or illustrate the instrument's complete pitch range. The program also provides the pronunciation of each instrument name (though these aren't always accurate, as in the case of the viol).

The sound quality of Musical Instruments isn't great, since the clips in .WAV format don't use the highest sampling quality. But this format makes for smaller file sizes, letting Microsoft cram more than 1,500 recordings onto the disk.

Though the entries don't provide long essays on the history of each instrument, they are very informative and let you pick up a number of fascinating tidbits. For example, *Musical Instruments* tells you that the nose flute of the Pacific Islands may owe its unusual playing technique to the belief of some Pacific Islanders that breath from the nos-



World music: Click on Musical Instruments' icons to sample the sounds of more than 200 instruments.

trils has special magic powers.

If you look up instruments by family, you'll get a brief discussion of the common characteristics of instruments in each category and subcategory. You'll also be surprised by the foreign relatives that many familiar instruments have: The program presents nine varieties of oboe and five different bagpipes from

around the world, for instance.

The Musical Ensembles option lets you explore the instruments in ensembles ranging from orchestras to Dixieland jazz bands to Javanese gamelans. You'll hear the music of the entire ensemble, as well as its individual instruments. You'll even see the seating arrangements.

Microsoft Musical Instruments belongs on the shelf of anyone interested in learning about music from around the world. It's not only educational, it's also great fun. □

Musical Instruments, \$79.95.
Requires: 4MB RAM,
Windows 3.1, CD-ROM drive,
sound board. Microsoft Corp.,
One Microsoft Way,
Redmond, WA 98052;
800-426-9400, 206-772-8080;
fax, 206-883-8101.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

I.B.M. Buys Catapult

PURCHASE, N.Y., April 14 (Reuters) — The International Business Machines Corporation has acquired Catapult Inc., a privately owned company that provides training in



First they give you the severance check, then they shake your hand, then SPROING!!!

How to Become a Buzzword

The New Hacker's Dictionary (MIT Press) includes several definitions for words that started out as people's names, such as **sagan**: *n.* A large quantity of anything. "The U.S. government spends sagans on bombs and welfare." From Carl Sagan and his TV show, "Cosmos." **biff**: *v.* To notify someone of incoming mail. From the BSD utility, which was named after the implementor's dog (it barked whenever the mailman came).

BUZZWORD WATCH

crossgrade To move from a DOS to a Windows version of the same product. **First heard:** Jackie Brinker, Symantec Corp.

picon A visual element in a multimedia application. **First heard:** Microsoft Multimedia Publishing Group, talking about the new Encarta Encyclopedia.

context-sensitive modality An intuitive interface. **First heard:** Mark Zimmer, president, Fractal Design Corp.

"Two Men Sentenced In Windows Trial"

"Two men reputed to be high-ranking Mafia figures were sentenced to long prison terms Friday for extortion and conspiracy. They were convicted in a major trial over accusations of mob control of the window-installation industry in New York City."

—THE NEW YORK TIMES,
MARCH 28, 1993



No, It's Not a Disk Degausser

Merritt Computer Products' Fastrack lets you keep your floppy disks close at hand. Just reach up and...OW...just got a static shock!



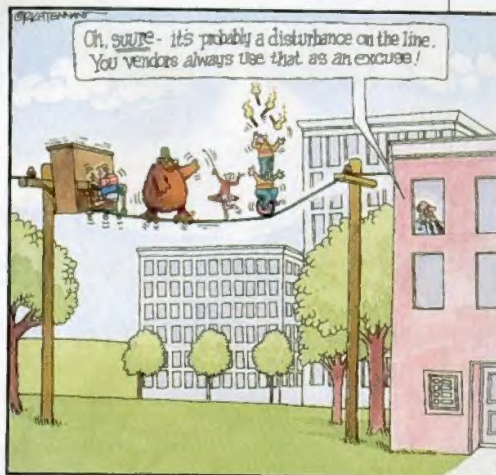
Here's to Your Hard Disk

The \$29.95 PC Bartender has more than 3,200 drink recipes. Developers at UneekWare said creating the program involved "over a year of research." The question is, how can they remember? (813-681-0061)

Will You Marry Me, Bill?

Wedding bells will soon be ringing for billionaire Microsoft CEO Bill Gates, but what do you get the guy who has everything?

- 1) A great floppy disk organizer?
 - 2) A Space Needle cocktail shaker with matching martini glasses?
- Send us your best suggestions.



Richard Tennant

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to: Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016. Winners this issue: Robert Meegan (catapult), William B. Pearce, Jr. (disk degausser).

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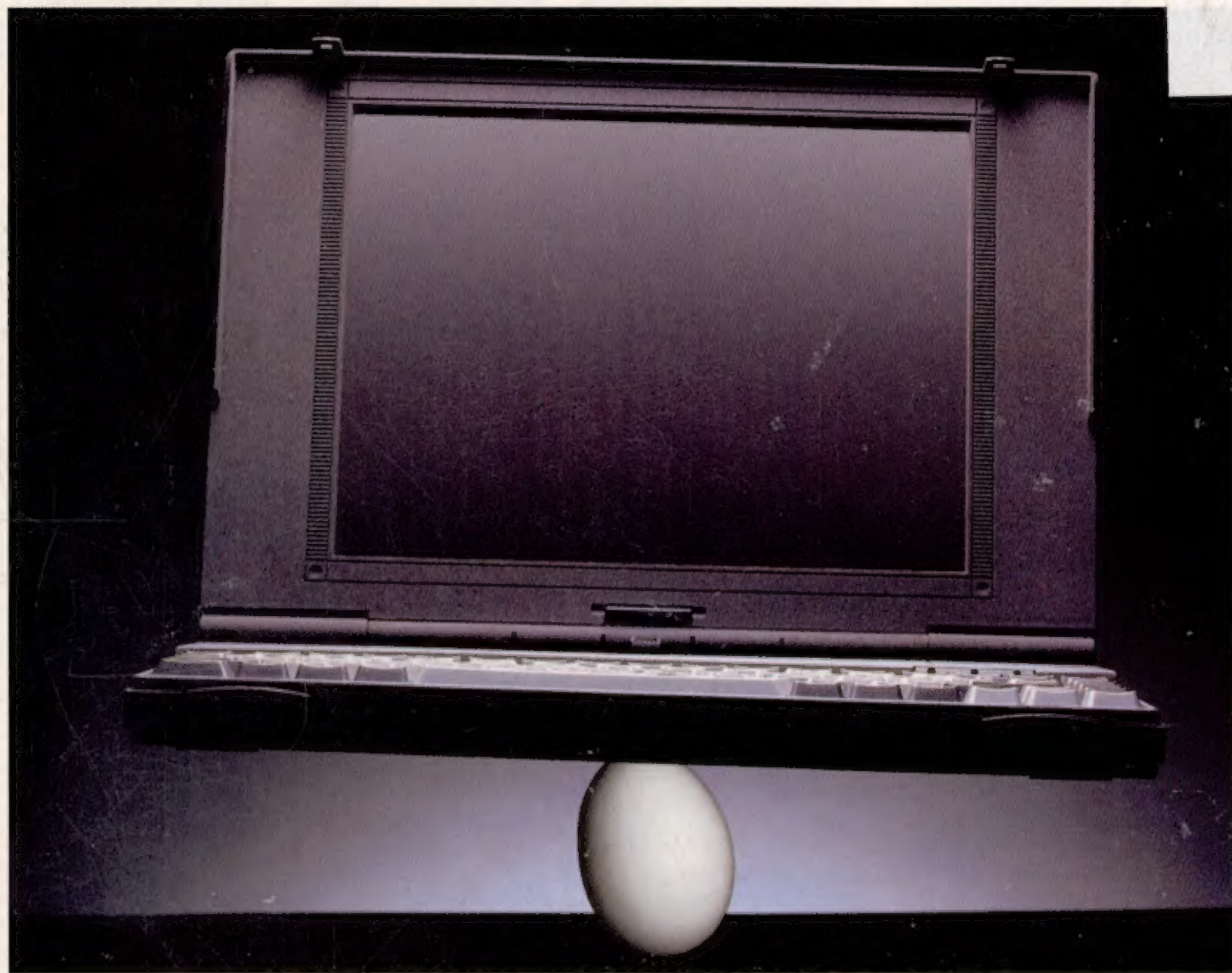
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